Conceptualizing Multimorbidities in Older Adults:
Chronic Pain, Depression, and the Biopsychosocial Model

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Abstract

Multimorbidity, a term referring to the co-occurrence of two or more chronic conditions, is increasing in global prevalence as individuals are living longer with varying disease clusters. Existing data has highlighted the significant association between multimorbidity, chronic pain, and depression. However, the nature of this relationship is poorly understood, largely due to an inconclusive understanding of disease clusters among older adults. The biopsychosocial framework provides an alternative model that incorporates multimorbidities and the impact of psychosocial variables in the conceptualization of overall health.

This study utilized a community sample of older adults (55 years of age and older) from Douglas County, Kansas (N=57). Participants completed six self-report measures assessing the presence of chronic conditions, pain, social support, physical disability, and access to health care. Participants reported an average of five (SD=1.86) chronic conditions. A multiple correspondence analysis support disease clustering according to body system. These findings may implicate latent systemic deficits as contributing factors to the development of similar chronic conditions.

Formative measurement models suggest that mental health conditions (e.g., depression, anxiety, and chronic pain; p<0.001), pulmonary diseases (e.g., COPD, chronic bronchitis, and asthma; p=0.01), and musculoskeletal conditions (e.g., arthritis, osteoarthritis, osteoporosis, and other musculoskeletal conditions; p=0.01) are significantly associated with depressive symptomatology. Measurement models further implicate mental health (p=0.04) and musculoskeletal conditions (p=0.03) as contributory elements in reported pain interference. Findings additionally discuss the contributing role of psychosocial factors, particularly physical

functioning, in depression and pain interference outcomes. The present paper also discusses clinical and research implications, as well as provides suggestions for areas for future research.

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I would like to dedicate this dissertation to my family, from whom I have learned the true meaning of love. They have taught me dedication, perseverance, and strength, and I am forever thankful for their undying support.

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Introduction

Chronic conditions are becoming increasingly prevalent worldwide and individuals are living longer with varying disease clusters (Read, Sharpe, Modini, & Dear, 2017). Prevalence rates of chronic diseases increase with age (Held et al., 2016; Moussavi et al., 2007). Currently, over 80% of adults 65 years and older have at least one chronic condition, and 70% have two or more (Centers for Disease Control and Prevention [CDC], 2016; National Council on Aging [NCOA], 2018; Pruchno, Wilson-Genderson, & Heid, 2016; Rocca et al., 2014). Chronic illnesses are the leading cause of disability and premature death (CDC, 2016; Hunter & Reddy, 2013), and account for 1.7 million deaths each year in the United States (CDC, 2016; World Health Organization [WHO], 2015).

In spite of the increasing prevalence of multiple chronic conditions (MCC) among older adults, a dearth of literature focuses on common disease clusters, the mechanisms contributing to these clusters, and their subsequent impact. Current research often focuses on single chronic conditions (Nardi et al., 2007), thus limiting the applicability of findings, particularly when applied to older adults. As a result, disease combinations (and the symptomatology inherent to these disorders) are poorly understood. Given the pervasiveness of MCC among older adults, it is necessary to study the disease combinations, rather than singular disorders, to truly understand their physiological and psychological impact.

Existing literature varies in terms of commonly clustered conditions. A systematic literature review conducted in 2013 detailed disease groupings, or clusters, among older adults. Notably, depression was the disease most frequently clustered with other chronic conditions, followed by diabetes mellitus and hypertension (Sinnige et al., 2013). The most prevalent disease combinations all included diabetes mellitus, hypertension, and coronary heart disease (Sinnige et

al., 2013). Other studies (e.g., Kirchberger et al., 2012) suggest hypertension and stroke to be a common disease pattern among older adults. Further research indicates sex differences with clusters, demonstrating a pattern of hypertension and cancer among males, and hypertension and arthritis among females (St Sauver et al., 2015). However, given differences in large study populations and research designs, there is a limited understanding of common disease clusters, particularly among older adults.

The mechanism of disease clustering is similarly unclear. Recent research suggests that diseases may cluster according to body system. Data indicate clustering within the cardiovascular and metabolic systems (e.g., Schafer et al., 2010; Sinnige et al., 2013; van den Bussche et al. 2011), the cardio-respiratory systems, (e.g., Garin et al., 2014) and the musculoskeletal system (e.g., Prados-Torres et al., 2012). While inconclusive, this suggests that latent characteristics (i.e., a functional deficit in one system) may contribute to the development of similar chronic conditions. For example, a secondary respiratory disease may develop in the context of asthma due to a compromised respiratory system. However, research is needed to better understand the etiology of disease clusters.

Comorbidities, Multimorbidities, and the Biopsychosocial Model

A small, but growing, research field has begun to focus on MCC. *Comorbidity* refers to a combination of disorders in addition to an index disease, where an index condition is defined as a the primary disorder of focus (Feinstein, 1970; Formiga et al., 2013; Mercer, Salisbury, & Fortin, 2014; Valderas, Starfield, Sibbald, Salisbury, & Roland, 2009; van den Akker et al., 1996). *Multimorbidity* refers to the co-occurrence of two or more chronic or acute conditions without an identifiable index disease (Formiga et al., 2013; Fortin et al., 2004; Richardson & Doster, 2014; van den Akker et al., 1996). This present paper will focus on multimorbidities, as presence of an

index disease is often physician-defined and does not always reflect the patient's experience of their chronic conditions (Nardi et al., 2007).

Current multimorbidity research focuses mainly on "chronic conditions," a term most frequently associated with medical diagnoses (e.g., diabetes, cancers, hypertension). This nomenclature often excludes chronic mental health conditions, which are largely absent in the multimorbidity literature. Given the significant correlation between multimorbidity and depression (Barnett et al., 2012; Moussavi et al., 2007; Read et al., 2017), this omission highlights a major shortcoming in the current research. The "chronic condition" terminology also excludes other physical health conditions, such as chronic pain. While pain is largely cited as a symptom of a disease process (e.g., arthritis, diabetes) or injury, recurring pain may be classified as an independent disease. Chronic and persistent pain is often comorbid with chronic illnesses (Goldberg & McGee, 2011; Kato, Sullivan, Evengard, & Pedersen, 2006; Krein, Heisler, Piette, Makki, & Kerr, 2005) and prevalence rates increase with age. However, similar to mental health conditions, chronic pain is largely omitted from the multimorbidity literature.

The limited available data indicate associations among multimorbidities, chronic pain, and depression. Unfortunately, current disease models, as well as clinical care guidelines, are developed around single diseases and are limited in their generalizability to those with multimorbidities (Kane, 2000, 2005; Nardi et al., 2007; Wallace & Howlett, 2016). The biomedical model suggests disease and illness originate due to biological dysfunction that is independent from psychosocial factors. This model fails to incorporate the psychosocial constructs that are independent of physical health but impact disease stability (Nardi et al., 2007). The biopsychosocial framework of health, proposed by George Engel (1977), presents a more inclusive model emphasizing the evolution of health governed by disease interactions as

well as by psychosocial factors. In order to conceptualize depression and chronic pain in the context of multimorbidities, these individual relationships must first be explored.

Multiple Chronic Conditions and Chronic Pain

Defining pain. The definition of "pain" varies widely in the literature and is often poorly assessed. Many studies do not employ a standardized measure to assess for pain, preferring to inquire after a history or current report of pain (Bair, Robinson, Katon & Kroenke, 2003; Dansie & Turk, 2013), and there is little uniformity in measurement selection. Some measures quantify pain by severity and interference in daily functioning, while others provide a measure of intensity (Hawker, Mian, Kendzerska & French, 2011). Qualitatively, these measures describe pain in different ways, making it challenging to compare across measures. Pain is further described in terms of its chronicity and/or acuity. Chronic pain is defined as persistent pain that typically exceeds six months and surpasses what is expected given the injury or illness (American Chronic Pain Association [ACPA], 2016). This differs from acute pain, which is classified as transient and having a distinct origin (ACPA, 2016). Acute pain often occurs in the context of chronic illnesses; however, for the purpose of this dissertation, all references to pain will refer to chronic pain.

Epidemiology of pain among older adults. An estimated 50-75% of older adults report experiencing chronic pain (Ezzati et al., 2014; Molton & Terrill, 2014). Sex differences are well documented, in which women more frequently report chronic pain (Fillingim, 2015). Biological (e.g., pain sensitivity, hormonal differences), psychological (e.g., coping strategies), and social (e.g., gender roles, socialized masculinity) processes are all causal factors in these findings (Fillingim, 2015).

In a study conducted by Barnett and colleagues (2012), over 85% of participants with chronic pain reported co-morbid chronic illness (Barnett et al., 2012). A separate study indicated over 70% of older adults with diabetes or heart failure experience persistent pain (Butchart, Kerr, Heisler, Piette, & Krein, 2009). Others have highlighted the significant associations between pain and arthritis, vascular disease, bronchitis, microvascular and musculoskeletal conditions, among others (Baker et al., 2017; Britt, Harrison, Miller, & Knox, 2008). Conditions associated with the respiratory and musculoskeletal systems, as well as cancers, are repeatedly associated with chronic pain (Lee, Goldstein & Brooks, 2017; Ohayon, 2005). This is due in part to the afflicted areas and recommended treatments. Among older adults, chronic pain is associated with poor quality of life, disrupted sleep patterns, low energy, difficulty concentrating, decreased immune system response, depression, and disability (Bernhofer & Sorrell, 2012).

Relationship between pain and MCC. A positive relationship exists between subjective pain and number of chronic conditions; those with multimorbidity are more likely to report moderate to severe levels of pain than those without or with a single illness (Butchart et al., 2009; Fayaz, Ayis, Panesar, Langford & Donaldso, 2016; Scherer et al., 2016; Slavich & Irwin, 2014). When presented in conjunction with chronic illnesses, chronic pain is significantly associated with psychological distress, decreased quality of life, impaired functional status, increased disability (both physical and perceived), and difficulty engaging in disease management (Beacham, Linfield, Kinman, & Payne-Murphy, 2015; Butchart et al., 2009; Onubogu, 2014). Further relationships have been demonstrated with increased severity and frequency of reported pain, complex disease courses, more frequent utilization of health care services, and significant health care spending (Britt et al., 2008; Sharpe et al., 2017). However, despite the increasing number of older adults living with multimorbidities, pain research among

older adults has largely focused on singular conditions (e.g., diabetes, arthritis, fibromyalgia); as such, little is understood regarding the effect of multimorbidities on the pain experience (Sharpe et al., 2017).

Various studies suggest that chronic pain is an independent outcome of chronic conditions (Chou, 2007; Geerlings, Beekman, Deeg, Twisk, & Van Tilburg, 2002; Scherer et al., 2016). However, other data suggest that chronic pain may be a unique disease entity, rather than a symptomatic outcome. While pain may arise as a symptom of a disease (e.g., diabetes, arthritis), physiological changes may occur in the peripheral nervous system leading to pain that is distinct from the initiating disease (Baker et al., 2017; Cousins, 2007). This resulting chronic pain has a unique, secondary pathology and symptom set (Baker et al., 2017; Cousins, 2007; Siddall & Cousins, 2004), thus qualifying it as a separate disease.

Pain interference and MCC. Pain is commonly assessed in terms of severity, intensity, frequency, and interference. Pain intensity and severity both qualify the pain experience, and are often represented using numeric ("Rate your pain on a scale from 1 to 10") or verbal ("Would you describe your usual level of pain as mild, moderate, or severe?") rating scales (Dansie & Turk, 2013). Pain frequency quantifies the amount of time in which pain is experienced. Pain interference, however, may be the most encompassing, as it provides a measure of pain with respect to functional ability (Dansie & Turk, 2013). Interference is assessed according to the following domains: ability to participate in physical functioning, ability to perform activities of daily living (ADLs, such as bathing, dressing, feeding), and ability to participate in social roles (e.g., employment; Dansie & Turk, 2013).

Pain interference among older adults is pervasive – a study conducted by Przekop and colleagues (2015) reported over half of older adults experience moderate to significant pain

interference (Przekop, Haviland, Oda & Morton, 2015). Further studies suggest interference may be positively correlated with age (Thomas, Peat, Harris, Wilkie & Croft, 2004). This is likely driven by high levels of perceived stress (consistent with multimorbidities), which are associated with increased pain interference among older adults (White et al., 2014). These findings are further reflective of duration of time in which pain is endured, as well as potential disability and loss of independence (Przekop et al., 2015).

Cumulative data describe the association between chronic illnesses, pain, and pain interference (Baker, O'Connor & Krok-Schoen, 2016). Pain impedes the ability to engage in activities necessary for an independent lifestyle (Baker et al., 2016; Stubbs et al., 2013). Older adults may avoid physical activities for fear of increased pain (i.e., the fear-avoidance model), which can result in muscle atrophy and physical limitations (Baker et al., 2016). As a result, chronic pain and high pain interference often lead to sedentary lifestyles and a reduction in overall physical activity. This in turn increases the likelihood of developing chronic health conditions (e.g., diabetes, cardiometabolic disease; Stubbs et al., 2013) and contributes to poor quality of life.

Much of the multimorbidity literature presents pain as a symptom or outcome rather than a co-occurring condition. Similarly, few studies have highlighted multimorbidity and chronic pain (specifically pain interference) as primary foci of study. It is further notable that little available data focus on disease clusters relative to pain interference. This highlights the paradoxical lack of research in this area, given the increasing prevalence of multimorbidities and chronic pain with age, as well as the well-documented incidence of pain and pain interference in the chronically ill.

Multiple Chronic Conditions and Depression

Defining depression. The Diagnostic and Statistical Manual of Mental Disorders-5 (DSM-5) defines depression as the presence of five or more of the following symptoms: depressed mood, anhedonia, unintentional changes in weight (gain or loss), disrupted sleep patterns, psychomotor agitation or retardation, fatigue, feelings of worthlessness and/or excessive guilt, difficulty concentrating, and suicidal ideation (American Psychiatric Association [APA], 2013). Consistent with chronic pain, existent research varies considerably in the definition and associated measurement of "depression." Some studies have employed self-report measures to quantify depressive symptoms (e.g., Arnow et al., 2009; Sharpe et al., 2017). Other studies (e.g., Ohayon & Schatzberg, 2010), defined depression according to clinical criteria for Major Depressive Disorder (MDD) as outlined in the Diagnostic and Statistical Manual of Mental Disorders-IV (DSM-IV; APA, 2000). As such, existing data may lack external validity due to the inconsistent diagnosis of "depression."

Epidemiology of depression. Current estimates suggest that roughly 30% of chronically ill older adults suffer from depression (Kessler & Bromet, 2013; Turvey & Klein, 2008). Sex differences have been observed, in which depression rates are significantly higher among older females (Girgus, Yang & Ferri, 2017). Identifying depressive symptoms among a chronically-ill older population can be challenging, given the overlapping somatic symptoms (Fiske, Wetherell & Gatz, 2009). Symptoms such as fatigue, weight changes, and sleep disruption are hallmark symptoms of depression, and are similarly common among medical conditions. Diagnostic challenges further arise as DSM-5 stipulates that major depressive disorder cannot be diagnosed if symptoms are specifically due to medical conditions (APA, 2013). Researchers suggest that the prevalence of depression among MCC populations may be inaccurate (both over and

underdiagnosed; Fiske et al., 2009). A meta-analysis indicated that overdiagnoses are particularly common in primary care settings (Mitchell, Vaze & Rao, 2009). Somatic symptoms may be overattributed to chronic conditions, leading to underdiagnoses. Physical illnesses may be similarly ignored, potentially resulting in overdiagnoses (Fiske et al., 2009). As such, epidemiological estimates may not be entirely reflective of the true prevalence of depression.

Depression is considered an independent outcome associated with chronic conditions in older adults. Symptom burden and functional impairment associated with multimorbidities are likely causal agents (Earnshaw & Quinn, 2012; Ford, 2008; Ludman et al., 2004; Richardson & Doster, 2014; Rutledge, Reis, Linke, Greenberg, & Mills, 2006; Turvey & Klein, 2008). The observed relationship between depression and chronic illness is bidirectional; as such, a worsening medical condition may lead to depressed mood (Ford, 2008; Violan et al., 2014). Conversely, a depressive episode may exacerbate existing chronic conditions, likely due to difficulty engaging in disease management and self-care activities.

Depression contributes substantially to disease burden (Gunn et al., 2012; Moussavi et al., 2007). A study conducted in 2007 found depression produced the greatest decrement in overall health when compared with other physical chronic diseases, such as arthritis, diabetes, or angina (Moussavi et al., 2007). When compared to healthy cohorts, individuals with depression report medical symptoms more frequently and qualify their symptoms as more severe, even when controlling for disease severity (Ford, 2008; Katon, 2011; Ludman et al., 2004; Sullivan, LaCroix, Spertus, & Hecht, 2000). Depression likely negatively affects the pathophysiology of disease due to increased activity in the autonomic nervous system, specifically in the hypothalamic-pituitary-adrenal and sympathetic-adrenal-medullary axes (Miller, Stetler, Carney, Freedland, & Banks, 2002; Walker, Gelfand, Gelfand, Creed, & Katon, 1996). This can lead to

physiologic effects such as decreased heart rate variability, elevated levels of inflammatory risk markers (Carney et al., 2000; Ford, 2008; Miller et al., 2002), and lasting neurophysiological effects (e.g., deficits in semantic and episodic memory, executive functioning, and processing speed; Carney et al., 2000; Herrmann, Goodwin & Ebmeier, 2007; Post, 1992). Depression also negatively impacts disease progression and outcome due to increased risk for functional disability, poor treatment adherence, and difficulty with self-care and disease management (DiMatteo, Lepper, & Croghan, 2000; Earnshaw & Quinn, 2012; Ford, 2008; Ludman et al., 2004; Sullivan et al., 2000; Walker et al., 1996).

Relationship between depression and MCC. There is a positive correlation between depression and total number of diagnosed chronic conditions (Barnett et al., 2012; Ford, 2008; Gunn et al., 2012; Moussavi et al., 2007; Violan et al., 2014). Not only does the presence of two or more chronic conditions increase the risk of depression (Bayliss, Steiner, Fernald, Crane, & Main, 2003), but also an increasing number of multimorbidities exacerbate the severity and occurrence of depressive symptoms (e.g., diminished energy, low mood, irritability; Barnett et al., 2012; Gunn et al., 2012; Moussavi et al., 2007). Individuals with an increasing number of multimorbidities may have negative perceptions of self-management and disease severity and may be more likely to perceive barriers to care.

Very little research sheds light on the relationship between multimorbidity and depression among older adults. Many of the existing studies focus on single diseases (e.g., diabetes, cancers) and include multimorbidities as secondary covariate predictors of depressive symptoms (e.g., Canoui-Poitrine et al., 2016; Lossnitzer et al., 2014). The literature lacks data focusing on depression as a unique disease entity that contributes to multimorbidity, instead highlighting depressive symptoms as an outcome of multimorbidity. Given the well-documented

interconnectedness of physical health conditions and depression, this presents as a significant weakness.

The literature is similarly devoid of information investigating the effect of specific disease clusters on mental health. Literature findings highlight the relationship between depression and chronic illnesses, but few studies compare depressive outcomes by disease or disease cluster. This significantly diminishes the external validity of current research as it applies to the older population for whom multimorbidity is the norm rather than the exception.

Chronic Pain and Depression

Defining "pain-depression dyad." A substantial body of literature documents the relationship between chronic pain and depression. Known as the "pain-depression dyad" (Bair et al., 2003), these two conditions have a reciprocal interaction and psychosocial variables such as stress, coping, and social support are factors of interest. The overlap between depression and chronic pain is substantial; 30-60% of those with chronic pain suffer from depression (Bair et al., 2003; Liu, Ye, Watson, & Tepper, 2010; McWilliams, Goodwin, & Cox, 2004). A population-based study reported depression to be three times more prevalent among subjects with chronic pain when compared to those without (Bair et al., 2003). As seen with multimorbidities, the co-occurrence of pain and depression is associated with worse health outcomes than when these disorders occur in isolation (Surah, Baranidharan, & Morley, 2014). Older adults experiencing co-morbid depression and chronic pain are more likely to report painful symptoms and pain-related impairment than those without a mood condition (Bair et al., 2003; Chou, 2007; Gallagher, Verma, & Mossey, 2000; Geerlings et al., 2002; Molton & Terrill, 2014; Reid, Eccleston, & Pillemer, 2015).

The relationship between chronic pain and depression is cyclical, where worsening depressive symptoms often result in a related increase in pain severity, which may further impact depressive symptom (Bair et al., 2003; Chou, 2007; Cocksedge, Simon, & Shankar, 2014; Eggermont, Penninx, Jones, & Leveille, 2012; Molton & Terrill, 2014). Central to this relationship is the pain schema that develops surrounding the pain experience. Pain-related fear, anxiety, catastrophizing, and helplessness are all factors contributing to the pain schema and weigh heavily on mental health (Quartana, Campbell, & Edwards, 2009). Poor schematic beliefs pertaining to pain (e.g., believe oneself to be unable to tolerate or function due to pain) and ineffective coping strategies lead to an increase in depressive symptomatology, which has a resulting intensification in pain experience (Campbell, Clauw, & Keefe, 2003; Quartana et al., 2009). Perhaps as a result, the pain-depression dyad is associated with increases in functional limitations and disability (Chou, 2007; Geerlings et al., 2002; Hadjistavropoulos et al., 2011), maladaptive attitudes and beliefs pertaining to pain and pain management, and poor social support and isolation (Gatchel & Epker, 1999; Li, 2015; Turk, 1997).

The presence of pain negatively impacts the recognition and treatment of depression (Wilson et al., 2014). In primary care and emergency settings, patients are more likely to ascribe their symptoms (e.g., fatigue, insomnia) to an ongoing illness or pain disorder (Bair et al., 2003). Depression often presents with somatic symptoms (e.g., psychomotor retardation, insomnia, lack of appetite, weight loss), which may easily be attributed to physical illness due to overlap in symptomatology. As patients are less likely to report anhedonia or dysphoria, depression is often overlooked and therefore undertreated (Bair et al., 2003).

Pain symptoms are associated with numerous chronic conditions (e.g., musculoskeletal diseases, cancers, pulmonary disorders). However, when older adults present with pain-related

symptoms, it is often a mental health condition, such as depressive symptoms, that underlies the medical visit (Bair et al., 2003). Older adults are more likely to report somatic symptoms, such as pain; more than half of depressed patients report only physical symptoms, the majority of which are pain-related (Bair et al., 2003). Depressive symptoms, the underlying cause of the complaint, is likely overlooked and subsequently untreated, which may result in worsening pain symptoms. As such, difficulty identifying mental health needs among this population is largely due to the symptom overlap among multimorbidities, pain, and depression.

Pain interference and depression. A positive correlation exists between pain interference and depression (Dalton, Higgins, Miller, Keefe & Khuri, 2015; Przekop et al., 2015). Numerous studies have cited depression as contributing to the expression of pain and pain interference (e.g., Dalton et al., 2015; Hanley, Raichle, Jensen & Cardenas, 2008). Reciprocally, pain interference may be a causal factor in the development of depression. Cuff and colleagues (2014) found pain interference explained 13% - 26% of the observed variation in depression scores among spinal cord injury patients (Cuff, Fann, Bombardier, Graves & Kalpakjian, 2014). Interference may have further implications for depression treatment, as high levels of pain interference are associated with decreased treatment efficacy among older adults (Mavandadi et al., 2007; Thielke, Fan, Sullivan & Unutzer, 2007).

For older adults, pain interference is likely multifactorial. Pain interference is associated with decreased pain tolerance, ineffective coping skills (Dalton et al., 2015), social isolation, difficulty completing daily tasks (Arola, Nicholls, Mallen & Thomas, 2010), and physical limitations (Baker et al., 2016), all of which are considered depressive risk factors. Older adults with depression may attend to painful stimuli more frequently, engage in greater pain catastrophizing, reduce activities due to fear avoidance, and rely on maladaptive coping

strategies (Arola et al., 2010). Among older adults, interference may be the most impeding quality of pain with considerable affective consequences.

Summary

In the context of multimorbidity, the relationship between pain and depression is further complicated and poorly understood. It is unclear the percentage of depression variation accounted for by pain alone, largely because much of the current pain-depression research has been conducted in samples in which pain is the most distressing symptom (e.g., fibromyalgia, rheumatoid arthritis; Sharpe et al., 2017). Further, measurement issues in the literature affect interpretation of depression and pain outcomes. Best practices regarding the assessment of depression and pain in relation to MCC have yet to be established, leading to questions pertaining to the external validity of available research. Additionally, the effect of pain and emotional status on disease is at the same time both well-known and poorly understood. Given these weaknesses, much remains to be determined regarding the ever-changing relationship between chronic pain and depression in the context of multimorbidities.

In sum, there lacks a conclusive understanding of the association between depression and chronic pain in the context of multimorbidity. Specifically, the relationship between pain interference, multimorbidity, and depression remains unclear, particularly among older adults. Few theoretical models have demonstrated the multifaceted relationships between these three constructs, and even less have incorporated an aging population. More research is necessary to better conceptualize the dynamic interactions among depression, multimorbidity, and chronic pain. The following section will propose a conceptual model to better understand this multifaceted relationship.

The Biopsychosocial Model as a Framework for Multimorbidities, Chronic Pain, and Depression

Historically, chronic illnesses are described by the biomedical model, which emphasizes mind-body dualism (Engel, 1977). Under this framework, disease and illness originate due to abnormalities in somatic processes (Wade & Halligan, 2004). These processes are independent of psychological and social dimensions; while outside sources (e.g., environment, lifestyle) may contribute to the disease outcome, they are not directly related to disease manifestation (Engel, 1977; Wade & Halligan, 2004). Under this framework, mental health conditions (e.g., depression, pain disorders) are separate from and unrelated to physical health conditions (e.g., diabetes). The patient is considered a passive recipient of their health and lifestyle factors, such as diet and exercise, do not contribute to disease manifestation.

However, the biomedical model was widely critiqued for its reductionist approach and inability to account for illnesses that lacked a clear etiology (e.g., chronic pain; Engel, 1977; Wade & Halligan, 2017). George Engel, in his seminal paper, proposed a new model that emphasized the psychological and environmental inputs that contribute to physiological states of health (Engel, 1977). The biopsychosocial model acknowledges the impact of factors such as mental health, lifestyle, and social determinants in the etiology of illness (Egger, Binns & Rossner, 2009). Health, then, is a combination of biological, social, cognitive, emotional, and environmental factors (Borrell-Carrio, Suchman & Epstein, 2004). The biopsychosocial model was the first to recognize that symptoms may arise from a multitude of sources (e.g., psychiatric conditions such as pain disorder or depression, cultural factors) that includes, but is not limited to, a single disease state (Hyman & Fleisher, 2011). Initially put forth to the psychiatric

community, the biopsychosocial model has become the prevailing model for the practice and underlying theories guiding health psychology (Adler, 2009; Johnson & Acabchuk, 2018).

The biopsychosocial model offers the most heuristic approach to conceptualizing multimorbidities, chronic pain, and depression. This model succeeds by unveiling the complex interactions between multiple chronic diseases as well as the influence of external factors (i.e., social determinants, lifestyle). Further, the biopsychosocial model considers interactions that vary by disease, by psychosocial inputs, and/or by individual. One must consider the individual variables of influence to include multimorbidities, depression, and chronic pain.

Defining Components of the Biopsychosocial Model. Established literature supports the conceptualization of depression and chronic pain from a biopsychosocial framework (Bevers, Watts, Kishino & Gatchel, 2016; Garcia-Toro & Aguirre, 2007). Considered the most holistic, this model validates the complex interaction of these domains in outward expressions of health. The biopsychosocial framework urges researchers and clinicians to consider the environmental, psychological, and biological mechanisms that contribute to disease and illness, thus conceptualizing the individual as a whole, rather than the sum of individual parts.

Given that, a biopsychosocial conceptualization of multimorbidities intimates that biological (e.g., MCC and chronic pain), psychological (e.g., depression) and social (e.g., sociodemographic characteristics) components contribute to overall health. Further, depression and chronic pain, specifically pain interference, may have significant implications for chronic disease progression and management. Physical and mental health may arise from dynamic and multifaceted interactions among multimorbidities, chronic pain, and depression. Further, these relationships may be non-linear, whereby a contextual change to one element (e.g., increase in pain interference) alters the environment for the remaining elements (e.g., multimorbidities and

depression; Kernick, 2006; Nardi et al., 2007). Biopsychosocial theory highlights the necessity of incorporating non-traditional diseases (e.g., chronic pain and depression) and external factors (e.g., sociodemographic characteristics), in addition to traditional physical chronic illnesses, in understanding multimorbidities. As such, it is crucial to consider depression and chronic pain as unique and as separate entities that interact *with* multimorbidities and contribute to diseases.

Limitations to Current Research

The term "chronic conditions" is not inclusive, nor is it representative of conditions leading to poor health outcomes, such as functional disability, poor quality of life, and early mortality. "Chronic conditions" research focuses largely on physical health conditions, such as diabetes, arthritis, and chronic obstructive pulmonary disease (COPD), and rarely includes depression and/or chronic pain. These are often cited as secondary covariates in statistical models or outcomes of chronic illnesses, rather than individual conditions of focus. Given the wealth of literature supporting the prevalence of both depression and chronic pain among older adults with multimorbidities, the exclusion is a significant limitation. The validity of this term would be strengthened if broadened to include chronic mental health and other physical conditions, such as depression and pain, which have similar health outcomes (Chang et al., 2010; Molton & Terrill, 2014; Scherer et al., 2016).

A second significant limitation to current multimorbidity research is the inconsistency in quantifying multimorbidities. Research to date varies regarding the most effective way to categorize and study multimorbidity, particularly among older adults (Held et al., 2016; Nardi et al., 2007). Current approaches lack the sophistication required to appropriately categorize varying disease clusters and presentations. For example, several studies have utilized the number of diagnosed diseases as a measure of multimorbidity, which assumes that all conditions

contribute equally to health outcomes, thus discounting interactions among specific conditions (Hermans & Evenhuis, 2014; Schafer et al., 2014; Sinnige et al., 2013). Prevalence rates provide aggregate data, which negate the psychosocial effects of multimorbidity (Scherer et al., 2016). Other authors have established a weighted index (e.g., Charlson Comorbidity Index) that accounts for the number and severity of chronic conditions. The weighted index approach relies on the most objectively "severe" illness at time of study and does not account for patient perception of illness (Guralnik, 1996; Nardi et al., 2007). Further studies have investigated pairs of diseases from the standpoint of an index condition (Nardi et al., 2007), which is subjective as it requires the identification of an index disease that may vary according to practitioner or specialist. Perhaps as a result, cluster patterns vary by study, thus limiting the clinical utility of findings.

A third, and perhaps the greatest limitation of the available research, is the underlying assumption that disease entities behave in conjunction as they do in isolation. Certain characteristics of mental and/or physical chronic illnesses may be constant across disease clusters and categories. However, the potential remains for oversimplifying (or misunderstanding) the complex interactions that occur for those diagnosed with multi-morbid chronic conditions. Current research invariably supports studying these conditions in isolation; many studies and clinical trials exclude participants with co-morbid or multi-morbid conditions (Nardi et al., 2007; Sinnige et al., 2013). As such, available data may lack external validity given the prevalence rates of multimorbidity, particularly among older adults. A biopsychosocial framework would support studying these diseases as they occur in clusters, rather than trying to generalize from single disease models.

Summary

Multimorbidities are pervasive among older adult populations. While prevalence rates are well established, limited data discuss common disease clusters and the mechanisms of clustering. A small body of literature suggests diseases may cluster by body system, indicating underlying systemic deficits that contribute to the development of similar chronic conditions. Extant data detail individual associations between MCC, depression, and chronic pain (specifically pain interference). However, few research studies present depression and pain as primary outcomes, particularly in the context of multimorbidities. Less remains clear about the potential effects of sex and race on disease clustering and the relationships with pain and depression. A biopsychosocial framework would support the inclusion of pain and depression as unique constructs in the conceptualization of multimorbidity and would emphasize the necessary addition of psychosocial factors (e.g., sex, race, social support, functional status).

Multimorbidities in older adults, non-traditional diseases (such as chronic pain and depression), psychosocial factors, and perceptions of health will be examined in this study. In order to truly understand the clinical presentation within this population, a multidimensional approach must be utilized that incorporates the circumstances contributing to chronic conditions, pain, and depression, as well as the myriad factors (e.g., sex, race, social support, perceptions of health, financial status, functional status) that may influence symptom expression. Therefore, the following four aims were investigated with this exploratory project:

Aim 1: To confirm the association between disease clusters and body systems.

Aim 2: To investigate the relationship between disease clusters, depressive symptom severity, and pain interference.

Aim 3: To better understand the influence of social support, perceptions of functional disability, and access to healthcare on the observed relationships among disease clusters, depression and pain.

Aim 4: To assess the impact of sociodemographic variables (e.g., age, sex, education, income, social support, functional disability, and access to healthcare) on the observed relationships among disease clusters, depression and pain.

Methods

Participants

Participants were a convenience sample of adults 55 years of age and older. Participants were recruited via the Senior Resource Center for Douglas County (SRC) in Lawrence, KS. The SRC provides services to older adults in Douglas County, assisting with transportation, health care, social activities, housing, and legal aid, among others. Study inclusion criteria was: 1) aged 55 years and older; and 2) self-reporting at least two chronic conditions. Exclusion criteria was: 1) < 55 years of age; 2) self-reporting one or no chronic illness; and 3) unable to provide consent. The final study sample included 57 older adults.

Recruitment. Four recruitment methods were utilized in this study. Flyers (Appendix A) were distributed in the SRC monthly newsletter, *Better Senior Living,* from November 2018–March 2019. Flyers were also provided to recipients of SRC services during this time period. The flyer contained a brief summary of the project and inclusion criteria, as well as contact information for the principal investigator. Interested participants were urged to contact the principal investigator and schedule an interview.

In-person interviews were conducted at the SRC during their Medicare open enrollment period from October 2018 – January 2019. Study team members were on-site to recruit

approximately ten hours each week, excluding the week of Thanksgiving and during winter break. Study flyers were distributed to Medicare enrollees (see Appendix A), who were also approached about the study. Roughly 80 potential participants were approached during this time; however, only seven consented to enrollment. Participants cited time conflicts, impending weather, and a general uneasiness regarding research as reasons for not consenting to participate.

In addition to the above methods, the SRC also provided a database of older adults in the Douglas County catchment area. Douglas County is composed of the following incorporated cities: Lawrence, Eudora, Baldwin City, and Lecompton. Recruitment letters (*n*=246; see Appendix B) were mailed to community members from November 2018 – February 2019 regarding the study. A week after mailing, follow-up calls were conducted to describe the project in further detail and assess interest in participating. Three attempts within two weeks were made to reach a participant before discontinuing efforts. A total of 46 participants were consented and enrolled from this recruitment method.

In efforts to increase study enrollment, an additional 140 older adults from the database were contacted without the accompanied letter (i.e., "cold calls"). Of those contacted, four consented and were enrolled in the study.

After consenting to enrollment (Appendix C), participants completed a survey consisting of six measures (Appendix D). Interviews (phone and in-person) lasted between 20 and 40 minutes. Recruitment efforts were terminated in mid-March 2019 after several community members approached the SRC with concern that their private information had been released without their consent. The SRC director subsequently requested that the private investigator cease enrollment.

Measures

Multimorbidities. Prevalence of chronic conditions was assessed via self-report. Participants were asked, "Has a doctor, nurse, or other health professional ever told you that you had any of the following?" Participants were provided with a list of chronic conditions; responses were in a yes/no format. In accordance with the National Council on Aging (2017), Centers for Medicare and Medicaid Services (2012) and Dana Farber Cancer Institute (2017), which report the most prevalent chronic conditions among older adults, the following were included in subsequent analyses: cardiovascular diseases (congestive heart failure [CHF], hypertension, coronary heart disease/coronary artery disease/ischemic heart disease), musculoskeletal diseases (osteoarthritis, rheumatoid arthritis, arthritis, osteoporosis, other musculoskeletal disorders,), chronic respiratory diseases (chronic obstructive pulmonary disorder [COPD], asthma, chronic bronchitis), cancer (prostate, lung, colon, breast, stomach), mental health (depression, chronic pain, and anxiety), and metabolic disorders (diabetes, chronic kidney disease, and other metabolic disorders).

Pain. Pain was measured using the Brief Pain Inventory (BPI; Cleeland, 1994). The BPI is a 32-item self-report assessment measuring pain interference and severity, both of which are scored as subscales. The Pain Severity subscale measures pain across four time points in the last week: the time at which pain was at its worst, least, average, and current (i.e., at time of completing survey; Cleeland, 2009). The Pain Interference subscale measures the degree to which pain interferes with seven daily activities (general activity, mood, walking ability, normal work, relations with other people, sleep, and enjoyment of life). Items are measured on an 11-point numeric rating scale (0-10), where higher scores indicate greater pain (Cleeland, 2009).

Mean scores are calculated for both domains, with higher scores again indicating greater reported pain interference and severity.

Factor analyses demonstrated strong support for the interference and severity subscale divisions (Cleeland & Ryan, 1994). Further analyses have indicated a hierarchical structure in the order in which participants report pain interference. Pain appears to interfere first with work, followed by mood, sleep, activities, walking, and finally relations with others (Cleeland, 1991). While initially designed for use with cancer-related pain, the BPI has been empirically validated with non-cancer pain (Keller et al., 2004; Stubbs, Eggermont, Patchay & Schofield, 2015), nonmalignant chronic pain (Tan, Jensen, Thornby & Shanti, 2004), and older adults (Stubbs et al., 2015). Reliability coefficients demonstrate strong test-retest reliability among cancer and non-cancer outpatients (severity, $r = 0.98$; interference, $r = 0.97$), medical inpatients (severity, $r = 0.72 – 0.95$; interference, $r = 0.81 – 0.93$), and patients with osteoarthritis (severity, $r = 0.83 – 0.88$; interference, $r = 0.83 – 0.93$; Cleeland, 2009). Alpha coefficients further support strong internal consistency for both subscales (severity, $0.80 < \alpha < 0.87$; interference, $0.89 < \alpha < 0.92$; Cleeland, 2009).

Depression. Depressive symptomatology was measured using the Geriatric Depression Scale, 15-item Short Form (GDS-15; Sheikh & Yesavage, 1986; Yesavage et al., 1982). The GDS-15 is an abbreviated version of the original 30-item Geriatric Depression Scale. These measures were designed to screen for depression among older adults (Sheikh & Yesavage, 1986). The Geriatric Depression Scales are noteworthy in their exclusion of somatic symptoms. Many depressive symptoms that are common among younger adults (e.g., insomnia, future-focused fear, loss of appetite) occur organically in the context of aging or illness in older adults

(McDowell, 2006); as such, questions assessing these symptoms are excluded from these measures.

Participants were asked to respond in a yes/no format. Examples of items include "Are you basically satisfied with your life," "Do you feel that your life is empty," and "Do you prefer to stay at home, rather than go out and do new things" (Sheikh & Yesavage, 1986). Five questions ("Are you basically satisfied with your life," "Are you in good spirits most of the time," "Do you feel happy most of the time," "Do you think it is wonderful to be alive now," and "Do you feel full of energy"), when answered negatively, are suggestive of depression; the remaining 10, when answered positively, suggest depression (Greenberg, 2007). One point is granted for each response that endorses a depressive symptom. Points are summed to give a score ranging from 0 – 15, where higher scores are suggestive of depression (Greenberg, 2007). While cut-points vary in the literature, scores below five are considered non-significant, scores ranging from 5 – 8 indicate mild depression, 9 – 11 indicate moderate depression, and 12 – 15 indicate to severe depression (Greenberg, 2007).

Considerable studies illustrate high internal consistency, both for the long and short form. Original validation studies were conducted in a community sample of older adults with and without depression (Yesavage et al., 1982). Findings revealed high internal consistency (α=0.94) when compared with the Hamilton Rating Scale for Depression (HRS-D) and the Zung Self-Rating Scale for Depression (SRS; α = 0.90 and 0.87, respectively). Additional studies have illustrated strong internal consistency for both forms when used among stroke (α = 0.90; Agrell & Dehlin, 1989), inpatient medical ($0.88 < \alpha < 0.93$; Lyons et al., 1989), and long-term care samples (α = 0.99; Lesher, 1986).

The GDS further demonstrated strong split-test reliability and test-retest reliability (r = 0.94 and 0.85; Yesavage et al., 1982). Results indicate strong convergent validity with the HRS-D (r = 0.83) and the SRS (r = 0.80). Other validation studies illustrate significant correlations with the Beck Depression Inventory (r = 0.85; McDowell, 2006) and the Center for Epidemiological Studies Depression (CES-D) scale (r = 0.82; McDowell, 2006).

Functional status. Functional status and disability were assessed using the World Health Organization Disability Assessment Schedule, 2.0 (WHODAS 2.0; Üstün, Kostanjsek, Chatterji, & Rehm, 2010). The WHODAS 2.0 is a 36-item self-report measure assessing generic levels of functioning across six domains (cognition, mobility, self-care, getting along, life activities, and participation; Üstün et al., 2010). The WHODAS 2.0 was developed using the International Classification of Functioning, Disability and Health (ICF), which provides a global framework for measuring health across three domains: body, person, and society (Üstün et al., 2010; WHO, 2018).

Items are presented according to domain. Participants were asked to reflect back over the past 30 days and indicate the level of difficulty they had completing activities, such as washing, taking care of household activities, and maintaining friendships. Responses options included "none," "mild," "moderate," "severe," and "extreme or cannot do." Participants were also asked to qualify the total number of days in which these difficulties persisted, days they were unable to complete usual activities due to poor health, and days they reduced activities due to health.

The WHODAS 2.0 offers two measures of scoring: "simple" and "complex" (Üstün et al., 2010). With simple scoring, all response options are assigned values ranging from one to five ("none" = one, "extreme or cannot do" = five). Responses are summed, with higher scores indicating greater functional disability. Simple scoring is limited in its utility, however, as it does

not provide domain-specific information pertaining to disability and should not be compared across populations (Üstün et al., 2010). Complex scoring utilizes item response theory (IRT), which accounts for the varying level of activity difficulty across item domains (Üstün et al., 2010). Items are differentially weighted according to severity. The resulting scores provide a measure of disability in each domain, as well as an overall summary score ranging from 0 to 100, where higher scores indicate greater disability (Üstün et al., 2010).

The WHODAS 2.0 provides a standardized measure of disability and functioning that is reliable across cultures and adult populations (Üstün et al., 2010). Global field research was conducted during measurement development and demonstrated strong internal consistency across the six domains ($0.87 < \alpha < 0.96$) and the global score ($0.97 < \alpha < 0.99$). Confirmatory factor analysis additionally supported the six domains and one global factor. Further, the WHODAS 2.0 has strong face validity, construct validity, as well as concurrent validity. Additional information pertaining to the factor structure and methodology is available in the WHODAS 2.0 manual (Üstün et al., 2010).

Social support. Perceived social support was measured using the Multidimensional Scale of Perceived Social Support (MSPSS; Zimet, Dahlem, Zimet & Farley, 1988). The MSPSS is a 12-item self-report measure that assesses adequacy of perceived social support in three areas - family, friends, and significant other (Zimet et al., 1988). Questions pertaining to familial support included, “My family really tries to help me,” “I get the emotional help and support I need from my family,” “I can talk about my problems with my family,” and “My family is willing to help me make decisions.” Questions pertaining to support from significant others included, “There is a special person who is around when I am in need,” “There is a special person with whom I can share my joys and sorrows,” “I have a special person who is a real

source of comfort to me," and "There is a special person in my life who cares about my feelings." Lastly, questions related to support from friends included, "My friends really try to help me," "I can count on my friends when things go wrong," "I have friends with whom I can share my joys and sorrows," and "I can talk about my problems with my friends."

Responses were presented on a 7-point Likert scale ranging from "very strongly disagree" to "very strongly agree," with higher scores indicating greater agreement with the prompt. Scores for each domain, as well as total score, were averaged with higher scores indicating greater perceived social support. While established cut-points are variable, the author suggests mean subscale scores 1 – 2.9 suggest low support, 3 – 5 suggest moderate support, and 5.1 – 7 high support (Zimet et al., 1988).

While initially developed and validated among university undergraduates (Zimet et al., 1988), recent studies have demonstrated this measure to be psychometrically sound among older adults with and without medical conditions and/or psychiatric diagnoses (Stanley, Beck & Zebb, 1998). Alpha coefficients indicate strong internal consistency for subscales and total measure (α = 0.87 – 0.94), as well as adequate to strong test-retest reliability for friends, family, and total score (r = 0.73, 0.74, and 0.73, respectively; Stanley et al., 1998). Test-retest reliability was weaker for significant others (r = 0.54); however, post-hoc analyses revealed no significant differences between scores at test and re-test (Stanley et al., 1998).

Initial construct validity was assessed using the hypothesis that social support is inversely related to depression and anxiety (Zimet et al., 1988). The MSPSS was compared to the Depression and Anxiety subscales of the Hopkins Symptom Checklist (HSCL). Results indicated significant inverse relationships with the Depression subscale and Family (r = -0.24), Friends (r = -0.24) and Significant Other subgroups (r = -0.13) and the total scale (r = 0-.25), suggesting a

relationship between low perceived social support and depressive symptoms. Subscales were further validated by comparing married to unmarried participants among the older adult sample. Validation was consistent with previous findings, suggesting that married participants perceive greater social support from family and friends, while unmarried participants perceive greater social support from friends (Stanley et al., 1998).

Access to health care. Participants were asked six questions falling under three domains: health care coverage, provision of health care services, and financial barriers to care. Questions pertaining to health care coverage included, "Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare and/or Medicaid," and "Do you have Medicare?" Questions regarding provision of health care services included, "Do you have one person you think of as your personal doctor or health care provider," and "How many times have you been to a doctor, nurse, or other health professional in the past 12 months?" Lastly, questions pertaining to medical costs included, "Was there a time in the past 12 months when you needed to see a doctor but could not because of cost," and "Was there a time in the past 12 months when you did not take your medication as prescribed because of cost?" These questions were adapted from the Behavior Risk Factor Surveillance System (BRFSS), a national health-related survey conducted annually by the CDC (CDC, 2018). They were chosen for their adequacy in identifying access to health care and health care utilization, as well as financial barriers to services. A full list of questions and corresponding response options is available in Appendix D.

Sociodemographic variables. Sociodemographic factors used in analysis included age, race/ethnicity, sex, marital status, education, occupation, and income. These were self-reported. Age was scored as a continuous variable. Education was assessed as the highest number of years

of formal schooling. Race/ethnicity (White/Caucasian, Black/African American, Hispanic, Asian, Other), sex (male, female, transgender), marital status (single/never married, married, living as if married, widowed, divorced, separated) and monthly income (0-499, 500-999, 1000-1499, 1500-1999, 2000+) were presented as categorical variables. As older adults often receive income from a variety of sources (retirement, disability), participants were also asked, "How satisfied are you with your present financial situation?" Responses were presented on a 6-point Likert scale, ranging from "Completely dissatisfied," to "Completely satisfied." Higher scores represented greater satisfaction. All sociodemographic variables included an "unsure" and "declined" option.

Statistical Analysis

Descriptive analyses were calculated using means, frequencies, and percentages. Due to the study aim concerning potential sex differences, analyses were also calculated across sex. Differences in sociodemographic variables, prevalence rates of chronic conditions, depressive symptom severity, pain severity and interference, perceptions of social support, and perceived functional impairment were calculated across sex using Chi-square, Fisher's Exact, and Welch's t-tests. Fisher's Exact tests were implemented in testing chronic conditions across sex for cases in which a condition was endorsed by less than five participants (Kim, 2017). Welch's t-tests were used to assess between-sex differences with adjustments for unequal variances. Analyses were conducted in R 3.4.3 (R Core Team, 2017) using the Psych (Revelle, 2018), FactoMineR (Le, Josse, & Husson, 2008), Factoextra (Kassambara & Mundt , 2017), and Lavaan (Rosseel, 2012) packages.

A multiple correspondence analysis (MCA) was conducted to test the hypothesis that diseases cluster according to body system (Figure 1; Avolio et al., 2013; Garcia-Olmos et al.,

2012; Guisado-Clavero et al., 2018). MCA is a descriptive statistical method that analyzes categorical variables for underlying patterns (Costa, Santos, Cunha, Cotter & Sousa, 2013). The results of MCA are similar to those achieved with factor analysis (Avolio et al., 2013). MCA produces a visual representation of categorical data in multidimensional Euclidean space; variable patterns are easily discerned as they occupy the same dimensional space (Costa et al., 2013; Guisado-Clavero et al., 2018). These groupings are referred to as "dimensions," the interpretation of which is based on the contribution of the variables.

The number of dimensions produced by MCA is equal to the number of included variables. The first dimension explains the largest proportion of the inertia (i.e., variance), with each subsequent dimension explaining successively less inertia. Dimensions were selected using two methods: parallel analysis and the "average rule" (Lorenzo-Seva, 2011). Parallel analysis

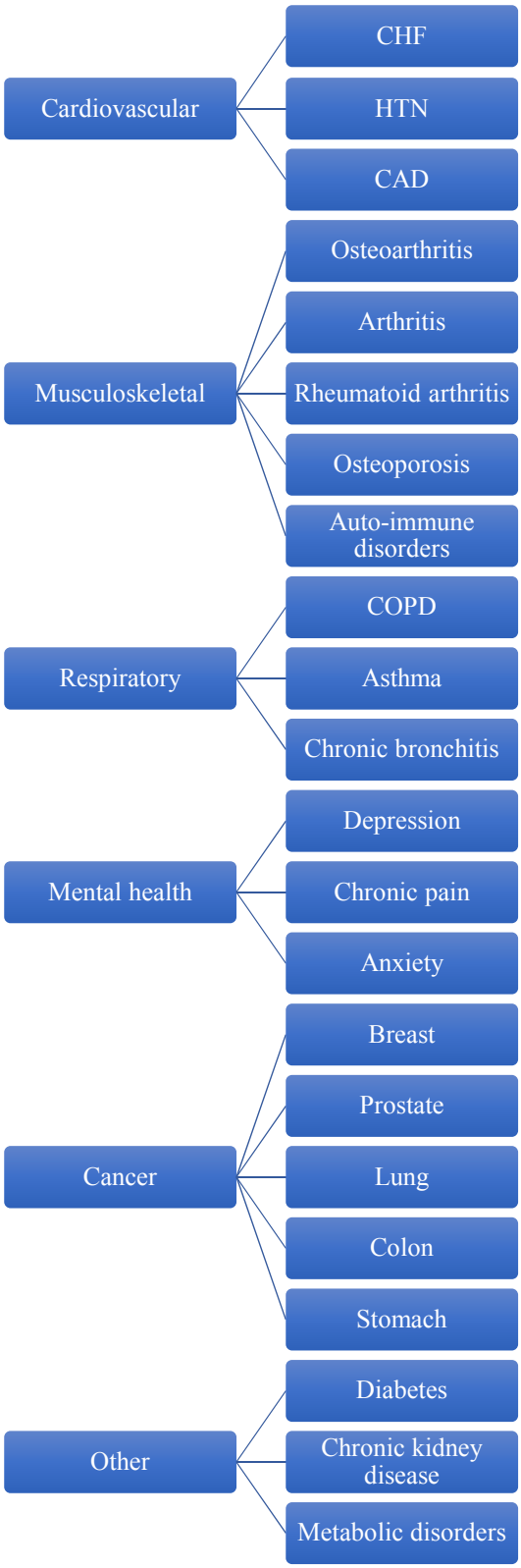

Figure 1. Proposed disease clusters.

compares the eigenvalues from the observed sample to the eigenvalues of randomly generated data (Fabrigar & Wegener, 2012). This simulated dataset is composed of the same number of variables and observations as the observed dataset. Parallel analysis suggests comparing the observed and simulated datasets; the number of dimensions to retain is the number at which the observed eigenvalues exceed the simulated eigenvalues (Fabrigar & Wegener, 2012). The "average rule" is similar to the Kaiser criterion for principal components analysis, in which the total inertia (100) is divided by the number of categories, and only dimensions with inertia greater than average are retained (Di Franco, 2016).

A series of formative measurement models under maximum likelihood estimation with robust standard errors were calculated using the results from the MCA. Formative measurement modeling is a type of structural equation modeling (SEM) that specifies a reversed directionality than typical measurement models (i.e., reflective measurement models; Kline, 2013). In brief, SEM is a form of statistical analysis that utilizes relationships among observed variables to assess latent constructs (Lomax & Schumacker, 2004). SEM relies on measurement models, which use observed variables to define latent constructs, and structural models, which calculate the proposed relationships between the latent constructs (Kline, 2015).

Formative measurement models are covariance structure models. These test whether indicators (i.e., observed variables) are causal contributors to an underlying factor (i.e., a latent composite; Kline 2013). Formative measurement models produce formative indicators, which are composite scores based on causal indicators. Indicators can then be used as predictors in statistical models. This type of model structure was selected given the hypothesis that latent deficits in a given body system will have an influence on depressive symptom severity and pain interference.

In this present study, formative measurement modeling was used to assess the relationships between disease clusters, depressive symptomatology, and pain interference. Disease clusters were latent constructs while depressive symptoms and pain interference were observed variables. The completely standardized solution was implemented as it standardizes the estimates for both latent and observed variables (Rosseel, 2012). Robust standard errors were calculated to account for potential misspecification of the model given the limited sample size (Freedman, 2006).

Results

Participant characteristics

A total of 57 participants were included for analyses. Most respondents identified as non-Hispanic White (95%), female (60%), and married or living as if married (60%). Participants reported a mean age of 72.43 years (*SD*=9.12 years). More than half of the sample had earned at least a college degree (61%) and reported an average monthly income greater than $2000 (54%). Given study aims investigating sex-related differences, the below results are presented both by the total sample, as well as by sex. Statistically significant differences were observed between sex with respect to marital status (X^2= 4.94, *p*=0.03), where females were more likely to be single/widowed/divorced (50%). The majority of the sample reported access to care (96%) and denied financial barriers to care (95%). Participant characteristics are summarized in Table 1.

Prevalence rates of chronic conditions. Participants reported an average of five (*M*=4.95, *SD*=1.86) chronic conditions, with the total number of reported conditions ranging from two to eleven (Table 2). Of the overall population, hypertension (64%), arthritis (54%) and chronic pain (67%) were among the most frequently reported chronic conditions. Hypertension (74%), chronic pain (70%) and depression (52%) were the most common diseases among males.

Table 1

Sample characteristics

	Total sample (*N* = 57)	Male (*N* = 23)	Female (*N* = 34)	*p*-value
Age (*M, SD*)	72.43 (*SD* = 9.12)	70.24 (*SD* = 8.26)	73.63 (*SD* = 9.44)	0.17
Gender (*N*, %)				
Female	34 (60%)	--	--	
Male	23 (40%)	--	--	
Race/ethnicity (*N*, %)				0.68
White/Caucasian	54 (95%)	22 (96%)	32 (94%)	
Hispanic/Latino	1 (2%)	0 (0%)	1 (3%)	
Other/Unknown	2 (4%)	1 (4%)	1 (3%)	
Marital status (*N*, %)				0.03*
Single/widowed/divorced	21 (37%)	4 (17%)	17 (50%)	
Married/Living as if married	36 (60%)	19 (83%)	17 (50%)	
Unknown	1 (2%)	0 (0%)	1 (3%)	
Education (*N*, %)				0.15
< College Degree	20 (35%)	5 (22%)	15 (44%)	
≥ College Degree	35 (61%)	17 (74%)	18 (53%)	
Unknown	2 (4%)	1 (4%)	1 (3%)	
Monthly household income				0.16
< 999	4 (7%)	0 (0%)	4 (12%)	
1000 - 1999	12 (21%)	3 (13%)	9 (21%)	
> 2000	31 (54%)	15 (65%)	16 (47%)	
Unknown/Declined	10 (18%)	5 (22%)	5 (15%)	
% with access to health care (*N*, %)	55 (96%)	22 (96%)	33 (97%)	0.85
% with Medicare (*N*, %)	51 (89%)	20 (87%)	31 (91%)	0.22
% with identified doctor or health care provider (*N*, %)	56 (98%)	23 (100%)	33 (97%)	0.90
% for whom cost was a barrier to receiving medical care (*N*, %)	3 (5%)	1 (4%)	2 (6%)	0.47
% that could not take medication because of cost barrier (*N*, %)	3 (5%)	1 (4%)	2 (6%)	0.47
Depression severity *(M, SD)*	2.88 (*SD*=3.29)	2.70 (*SD*=3.69)	2.82 (*SD*=3.05)	0.89
Number individuals endorsing ≥ mild depressive symptoms (*N*, %)	11 (19%)	6 (26%)	5 (15%)	

Participants endorsing chronic pain (*N*, %)	36 (60%)	14 (61%)	22 (65%)	0.77

**p<0.05, **p<0.01, ***p<0.001*

Table 2

Prevalence rates of chronic conditions

	Total sample (*N* = 57)	Male (*N* = 23)	Female (*N* = 34)	*p*-value
Number of chronic conditions (*M, SD*)	4.95 (*SD*=1.86)	4.57 (*SD*=2.00)	5.21 (*SD*=1.74)	0.22
Congestive heart failure (*N*, %)	5 (9%)	2 (9%)	3 (9%)	1.00
Hypertension (*N*, %)	37 (64%)	17 (74%)	20 (59%)	0.37
Coronary artery (*N*, %) disease/ischemic heart disease (*N*, %)	3 (5%)	2 (9%)	1 (3%)	0.56
Arthritis (*N*, %)	31 (54%)	10 (43%)	21 (62%)	0.28
Osteoarthritis (*N*, %)	23 (40%)	7 (30%)	16 (47%)	0.33
Rheumatoid arthritis (*N*, %)	2 (4%)	1 (4%)	1 (3%)	1.00
Osteoporosis (*N*, %)	11 (19%)	3 (13%)	8 (24%)	0.50
Other musculoskeletal disorder (*N*, %)	15 (26%)	1 (4%)	14 (42%)	0.002**
Chronic obstructive pulmonary disease (COPD; *N*, %)	5 (9%)	0 (0%)	5 (15%)	0.07
Asthma (*N*, %)	13 (23%)	7 (30%)	6 (18%)	0.42
Chronic bronchitis (*N*, %)	8 (14%)	2 (9%)	6 (18%)	0.45
Prostate cancer (*N*, %)	0 (0%)	0 (0%)	0 (0%)	--
Lung cancer (*N*, %)	1 (2%)	1 (4%)	0 (0%)	0.40
Colon cancer (*N*, %)	2 (4%)	1 (4%)	1 (3%)	1.00
Breast cancer (*N*, %)	6 (11%)	0 (0%)	6 (18%)	0.07
Stomach cancer (*N*, %)	0 (0%)	0 (0%)	0 (0%)	--
Other cancer (*N*, %)	19 (33%)	8 (35%)	11 (32%)	1.00
Diabetes (*N*, %)	8 (14%)	2 (9%)	6 (18%)	0.45
Chronic kidney disease (*N*, %)	1 (2%)	1 (4%)	0 (0%)	0.40
Other metabolic disorder (*N*, %)	0 (0%)	0 (0%)	0 (0%)	--
Depression (*N*, %)	28 (49%)	12 (52%)	16 (47%)	0.91
Anxiety (*N*, %)	24 (42%)	11 (48%)	13 (38%)	0.66
Chronic pain (*N*, %)	38 (67%)	16 (80%)	22 (65%)	0.92
Other chronic condition (*N*, %)	29 (51%)	11 (48%)	18 (55%)	0.96

**p<0.05, **p<0.01, ***p<0.001*

Chronic pain (65%), arthritis (62%) and hypertension (58%) were most frequently reported conditions among females. Fisher's Exact test indicated females were significantly more likely than males to endorse additional musculoskeletal conditions, such as fibromyalgia and polymyalgia rheumatica (p=0.002). Statistical differences were not observed between the remaining chronic conditions with respect to sex.

Depressive symptom severity. On average, participants reported subthreshold depressive symptoms (M=2.77, SD=3.29, range=0 – 12). Between-sex differences were assessed using Welch's t-test to adjust for unequal variances. Analyses revealed no statistical difference by sex.

Table 3

Geriatric Depression Scale

	Total sample (N = 36)	Male (N = 14)	Female (N = 22)	p-value
Depression severity *(M, SD)*	2.88 (SD=3.29)	2.70 (SD=3.69)	2.82 (SD=3.05)	0.89
Number individuals endorsing ≥ mild depressive symptoms (*N, %*)	11 (19%)	6 (26%)	5 (15%)	

Pain. The majority of participants reported a history of chronic pain (67%). Overall, participants reported an average pain interference score of 3.76 (SD=2.50, range=0.14 – 8.57) and severity score of 3.69 (SD=1.78, range=0.75 – 8.25; see Table 3). Between-sex differences were assessed using Welch's t-tests to adjust for unequal variances. While insignificant, females reported greater pain interference than males with respect to all domains, including overall pain interference (M=4.02 and 3.32, respectively), activity-related (M=4.82 and 3.71, respectively), and mood-related interference (M=3.35 and 2.95, respectively). Analyses indicate females experience the greatest functional impairment in the domains of normal work (M=5.32,

SD=3.71), general activity (*M*=4.68, *SD*=3.00), and walking ability (*M*=4.45, *SD*=4.03). Males reported the greatest functional impairment in the same domains (*M*=3.64, *SD*=3.46; *M*=3.64, *SD*=2.87; *M*=3.86, *SD*=3.37, respectively), as well as mood (*M*=3.71, *SD*=3.22). Similarly, while the overall pain severity score was not statistically different between sexes, (*p*=0.42), females experience more severe pain across all time points.

Perceptions of social support. Perceptions of social support are reported according to support from family, friends, and significant others, as well as overall social support (Table 4). Scores for each domain range from 1-7, with higher scores indicating greater perception of support. Welch's t-tests were again conducted to assess for between-sex differences with respect

Table 4
Brief Pain Inventory

	Pain sample (*N* = 36)	Male (*N* = 14)	Female (*N* = 22)	*p*-value
Total pain interference score	**3.76 (2.50)**	**3.32 (2.75)**	**4.04 (2.35)**	**0.42**
Activity-related interference	4.39 (3.13)	3.71 (3.07)	4.82 (3.15)	0.31
Mood-related interference	3.19 (2.57)	2.95 (2.59)	3.35 (2.61)	0.66
General activity (*M, SD*)	4.28 (2.95)	3.64 (2.87)	4.68 (3.00)	0.31
Mood (*M, SD*)	3.91 (3.19)	3.71 (3.22)	4.05 (3.24)	0.77
Walking ability (*M, SD*)	4.22 (3.75)	3.86 (3.37)	4.45 (4.03)	0.63
Normal work (*M, SD*)	4.66 (3.66)	3.64 (3.46)	5.32 (3.71)	0.18
Relations with others (*M, SD*)	2.31 (3.10)	2.07 (2.89)	2.45 (3.28)	0.72
Sleep (*M, SD*)	3.56 (3.28)	3.21 (3.26)	3.77 (3.35)	0.62
Enjoyment of life (*M, SD*)	3.36 (2.96)	3.07 (2.84)	3.55 (3.08)	0.64
Pain severity score	**3.69 (1.78)**	**3.41 (1.32)**	**3.86 (2.03)**	**0.42**
Worst pain in the last week (*M, SD*)	6.31 (2.07)	5.93 (1.14)	6.55 (2.48)	0.32
Least pain in the last week (*M, SD*)	1.86 (1.79)	1.79 (1.89)	1.91 (1.77)	0.85
Average pain in the last week (*M, SD*)	3.86 (1.69)	3.79 (1.25)	3.91 (1.95)	0.82
Current pain in the last week (*M, SD*)	2.72 (2.71)	2.14 (1.96)	3.09 (3.08)	0.27

to perceptions of social support. Participants reported high perceptions of perceived social support (total social support, *M*=5.51, *SD*=1.35, range=1 – 7). Notably, the sample reportedly derives the greatest support from significant others (*M*=5.97, *SD*=1.37, range=1 – 7), followed by friends (*M*=5.38, *SD*=1.60, range=1 – 7) and family (*M*=5.34, *SD*=1.71, range=1 – 7). While insignificant, males perceived greater overall social support than females, (*p*=0.59). Males reported finding greatest social support from significant others (*M*=6.28, *SD*=1.00) and family (*M*=5.30, *SD*=1.88), while females received greatest social support from significant others (*M*=5.76, *SD*=1.55) and friends (*M*=5.39, *SD*=1.44).

Table 5

Perceptions of social support

	Total sample (*N* = 57)	Male (*N* = 23)	Female (*N* = 34)	*p*-value
Total social support	5.51 (1.35)	5.74 (1.28)	5.42 (1.39)	0.37
Significant other *(M, SD)*	5.97 (1.37)	6.28 (1.00)	5.76 (1.55)	0.13
Family *(M, SD)*	5.34 (1.71)	5.64 (1.59)	5.13 (1.78)	0.26
Friends *(M, SD)*	5.38 (1.60)	5.30 (1.88)	5.39 (1.44)	0.78

Functional status. The WHODAS 2.0 provides a measure of functional ability across six domains, as well as an overall ability score. Scores range from zero to 100, with higher scores indicating greater disability. Between-sex differences were assessed using Welch's t-tests to adjust for unequal variances. Participants reported greatest functional impairment in the areas of getting around (*M*=26.97, *SD*=28.20, range=0 – 87.50) and life activities (*M*=22.91, *SD*=26.71, range=0 – 80). Analyses indicate both males and females experience the greatest disability in getting around (females, *M*=31.62, *SD*=29.07; males, *M*=20.11, *SD*=26.97). Domain comparisons by sex did not differ significantly ($0.10 < p < 0.96$).

Table 6

World Health Organization Disability Assessment Schedule 2.0

	Total sample ($N = 57$)	Male ($N = 23$)	Female ($N = 34$)	p-value
Overall score (*M, SD*)	17.49 (17.17)	15.97 (18.87)	18.58 (16.07)	0.59
Understanding and communicating (*M, SD*)	10.35 (16.47)	11.96 (20.66)	9.26 (13.15)	0.58
Getting around (*M, SD*)	26.97 (28.20)	20.11 (26.97)	31.62 (29.07)	0.12
Self-care (*M, SD*)	11.40 (19.95)	13.04 (22.45)	10.29 (18.34)	0.63
Getting along with people (*M, SD*)	11.11 (18.66)	11.59 (22.01)	10.78 (16.35)	0.88
Life activities (*M, SD*)	22.91 (26.71)	16.09 (23.50)	27.82 (28.14)	0.10
Participation in society (*M, SD*)	19.94 (19.91)	19.93 (23.40)	19.61 (17.54)	0.96

Confirmation of Multimorbidity Patterns

As no significant differences were observed between sex and prevalence of chronic conditions (p=0.77; see Table 2), a multiple correspondence analysis (MCA) was conducted on the entire sample. Disease categories (e.g., musculoskeletal, mental health) were included in analyses if they were composed of at least three unique diseases, and each disease was reported by greater than five individuals. Disease categories were excluded from analysis if they were not composed of at least three unique diseases, with each disease endorsed by greater than 5 participants. This methodology is consistent with general rules of thumb pertaining to correspondence inclusion.

Three disease categories were included in the multiple correspondence analysis: musculoskeletal (arthritis, osteoarthritis, osteoporosis, and other musculoskeletal conditions; reported by 75% of participants), respiratory (COPD, asthma, and chronic bronchitis; 32% of participants), and mental health (depression, anxiety, and chronic pain; 86% of participants). Cardiovascular diseases, metabolic diseases, rheumatoid arthritis, and cancers were excluded from analyses as the majority of subgroup conditions were endorsed by five or less participants (see Table 2), thus making them ineligible to be included in statistical analyses. It was deemed

that the "other chronic condition" category was not specific to a body system and was excluded as it would not lend to a meaningful comparison with the larger disease categories.

Four dimensions (Respiratory, Musculoskeletal, Mental Health, and Musculo-pulmonary [osteoporosis, osteoarthritis, arthritis, and chronic bronchitis]) were selected based on parallel analysis as well as general rules regarding dimension retention (Lorenzo-Seva, 2011). The four dimensions explained 62% of the observed variance (Table 6). The first dimension (Respiratory), explaining 19% of the dimensional inertia (i.e., variance), was composed of COPD, asthma, and bronchitis. Findings suggest that individuals who report a respiratory disease are more likely to report another respiratory disease. Dimensions two (Musculoskeletal) and four (Musculo-pulmonary), explaining 16% and 12% of the variance respectively, were composed of musculoskeletal conditions, as well as chronic bronchitis in the second dimension. Similarly, these results suggest that individuals who endorse musculoskeletal conditions likely report co-morbid or multimorbid musculoskeletal diseases. The third dimension (Mental Health), composed of depression, anxiety, and chronic pain, explains 15% of the observed variance; this dimension, as seen with the previous three, indicates that mental health conditions often occur simultaneously within this sample. These dimensions are primarily composed of diseases in the same category and were thus determined to support the initial aim of this study.

Relationships between depression and patterns of multimorbidity

Formative measurement models were specified using the mental health, respiratory, and musculoskeletal groups, as confirmed by the multiple correspondence analysis. As previously stated, formative measurement modeling is a type of structural equation modeling that specifies reverse directionality. These models depict observed indicators as causal contributors to a latent

Table 7

Multiple Correspondence Analysis of Diseases

	Quality of representation (cos^2)	Variable contribution (%)	Dimension inertia (%)	Total inertia (%)
Total sample				62.00
Dimension 1			19.28	
COPD	0.54	25.46		
Asthma	0.48	19.37		
Chronic bronchitis	0.30	13.38		
Dimension 2			15.59	
Osteoporosis	0.46	23.87		
Arthritis	0.28	8.11		
Osteoarthritis	0.28	10.57		
Chronic bronchitis	0.25	13.99		
Dimension 3			14.78	
Depression	0.54	18.69		
Anxiety	0.45	17.57		
Chronic pain	0.20	4.54		
Dimension 4			12.08	
Other musculoskeletal conditions	0.42	25.87		
Osteoarthritis	0.40	19.61		
Arthritis	0.23	8.86		

Note: cos^2 refers to the quality of the categorical representation, and ranges from 0 to 1.

construct. Composite scores were manually calculated given evidence of difficulty with model convergence in cases with more than one composite (Grace & Bollen, 2008).

The first model (Figure 2) tested whether disease categories, as latent constructs, were associated with depressive symptom severity, while simultaneously assessing observed relationships with pain interference, perceived social support, functional disability, and sociodemographic variables. Three indicators (mental health, respiratory, and musculoskeletal), total perceived social support, functional impairment, pain interference, and sociodemographic variables (age, marital status, income, sex, race, educational attainment) were included in the model. These variables were selected due to a priori study aims investigating relationship among biopsychosocial factors, depression severity, and pain interference. The musculo-pulmonary dimension, questions pertaining to healthcare access, pain severity, and the subdomains of the MSPSS and the WHODAS 2.0 were excluded from the measurement models as they produced a positive-indefinite covariance matrix, indicating that the model was not properly specified.

Model fit indices suggest a strong model fit (RMSEA<0.001, SRMR<0.001, TLI>0.99); however, the Chi-square value is small (X^2<0.001), and model fit indices may be reflective of the small sample size. As such, results should be interpreted with caution. All three composite indicators were significantly predictive of depressive symptom severity (Table 7). Functional impairment (β=0.48, p=0.01) was significantly predictive of increased depressive severity. Pain interference (β=-0.12, p=0.43), social support (β=-0.08, p=0.63), educational attainment (β=-0.18, p=0.15), and sex (β=-0.22, p=0.08) were not significantly associated with depressive symptom severity.

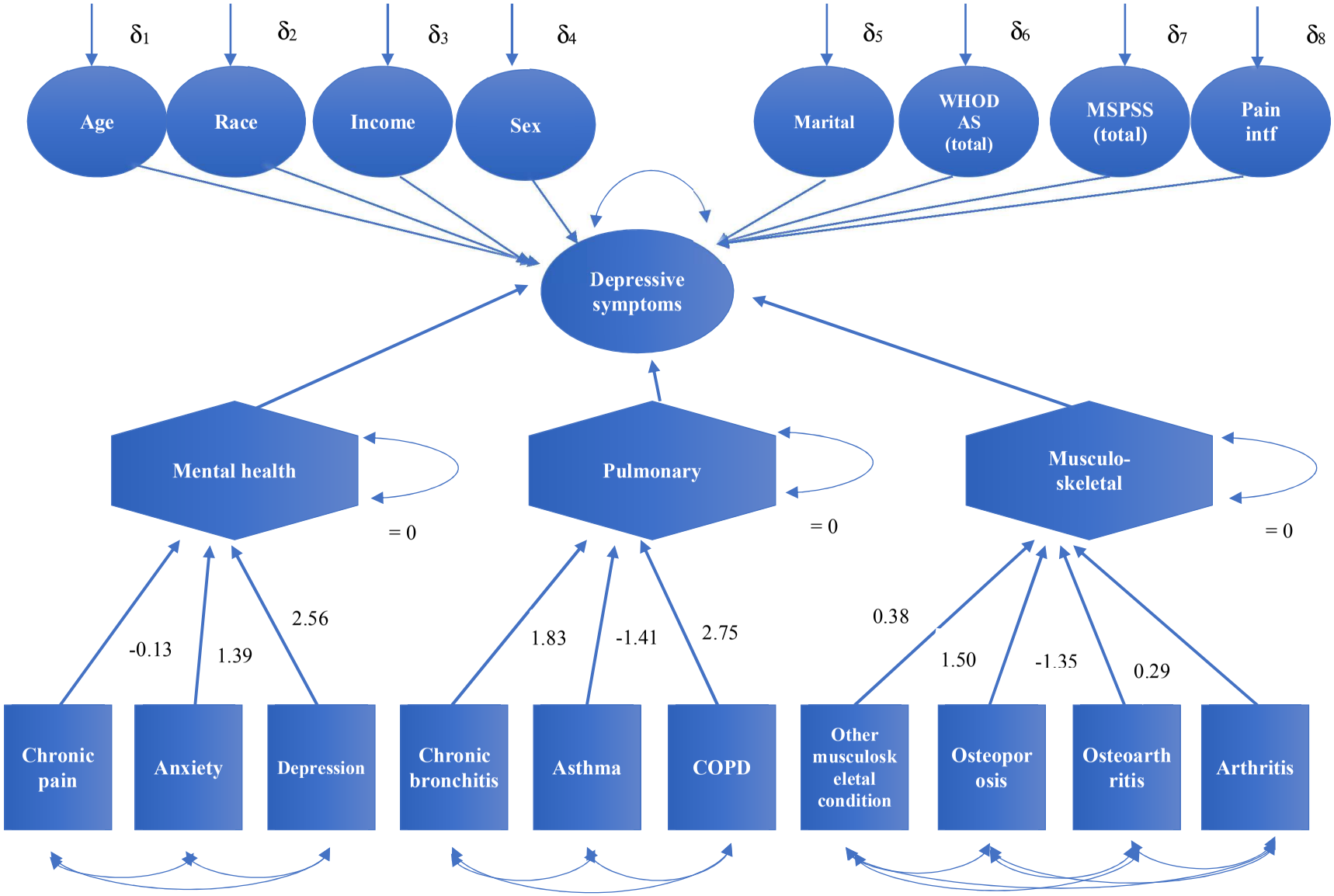

Figure 2. Structural equation model of depressive symptom severity. This model measures depressive symptomatology, as measured by disease composite indicators, functional impairment (total), social support (total), pain interference, and sociodemographic variables.

Table 8

Model predicting depressive symptom severity

	Standardized ß	SE	*p*-value
Mental health diseases	0.55	0.10	<0.001***
Pulmonary diseases	0.31	0.11	0.01**
Musculoskeletal diseases	0.28	0.11	0.01*
Age	-0.06	0.14	0.68
Marital status	-0.01	0.13	0.96
Income	-0.03	0.14	0.85
Sex	-0.22	0.12	0.08
Race	-0.24	0.12	0.04*
Educational attainment	-0.18	0.12	0.15
Perceived social support (total)	-0.08	0.17	0.63
Functional impairment	0.48	0.18	0.01*
Pain interference	-0.12	0.15	0.43
R^2	0.74		

*p<0.05; **p<0.01; ***p<0.001

Relationships Between Pain Interference and Patterns of Multimorbidity

An additional formative measurement model was specified to investigate the association between disease categories and pain interference, while simultaneously assessing relationships with depressive symptoms severity, perceived social support, functional disability, and sociodemographic variables (Figure 3). As with the previous model, variables were selected due to a priori study aims. The following variables were included in the model: mental health, musculoskeletal, and respiratory indicators, total perceived social support, functional impairment, depressive symptoms, and sociodemographic variables (age, marital status, income, sex, race, educational attainment). Similarly, the inclusion of the musculo-pulmonary indicator, health care access, pain severity, and WHODAS2.0 and MSPSS subgroups led to a positive-indefinite covariance matrix and were thus excluded from analysis.

Model fit indices indicate strong model fit (RMSEA<0.001, SRMR<0.001, TLI>0.99). However, as with the previous measurement model, results should be interpreted with caution as

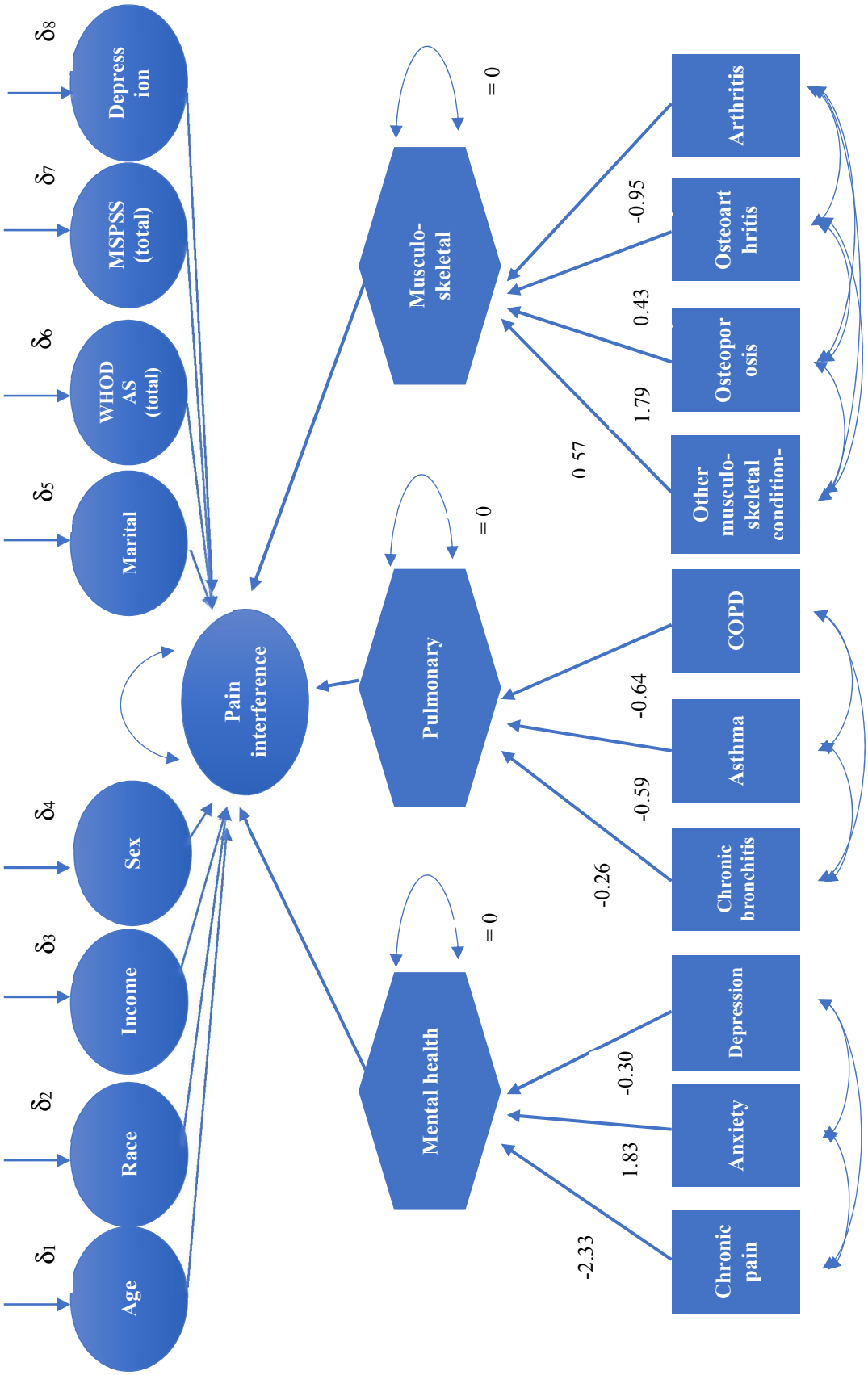

Figure 3. Structural equation model of pain interference. This model measures pain interference, as measured by disease composite indicators, functional impairment (total), social support (total), depressive symptomatology, and sociodemographic variables.

the Chi-square statistic is small (X^2<0.001). The mental health composite (β=0.28, p=0.04), younger age (β=-0.52, p=0.001), and functional impairment (β=0.84, p<0.001) were significantly predictive of pain interference (Table 8). Similar to the previous model, depressive symptoms were not related to pain interference (β=-0.16, p=0.44). Respiratory diseases (β=-0.11, p=0.46), marital status (β=-0.14, p=0.43), and income (β=-0.09, p=0.49) were also not significantly related to pain interference.

Table 9

Model predicting pain interference

	Standardized ß	SE	*p*-value
Mental health diseases	0.28	0.14	0.04*
Respiratory diseases	-0.11	0.15	0.46
Musculoskeletal diseases	0.24	0.11	0.03*
Age	-0.52	0.15	0.001**
Marital status	-0.14	0.18	0.43
Income	-0.09	0.13	0.49
Sex	0.19	0.15	0.19
Race	0.02	0.10	0.86
Educational attainment	-0.09	0.13	0.48
Perceived social support (total)	0.21	0.23	0.35
Functional disability	0.84	0.16	<0.001***
Depressive symptom severity	-0.16	0.21	0.44
R^2	0.64		

*p<0.05; **p<0.01; ***p<0.001

Discussion

The present study assessed patterns of multimorbidity among older adults, and the relationships between disease clusters, depressive symptom severity, and pain interference. Findings from this study suggest that multimorbidity may be more likely to co-occur in the same functional system (e.g., pulmonary, musculoskeletal). This may implicate systemic deficits that contribute to the development of similar chronic conditions. Results further imply that particular disease clusters, such as mental health (i.e., reported history of depression, chronic pain, and

anxiety) and pulmonary conditions (i.e., COPD, chronic bronchitis, and asthma), may be associated with increased depressive symptom severity and pain interference among older adults. These findings underscore the relationship between physical and mental health and contribute to the growing field investigating multimorbidities among older adults.

Associations Between Disease Clusters and Body Systems

Findings in the present study revealed an association between disease clusters and body systems (e.g., pulmonary, musculoskeletal, mental health systems). This supports the theoretical clustering by body system and may insinuate that systemic deficits contribute to the development of similar chronic diseases.

Participants reported chronic conditions occurring across four groups of systemic disease dimensions: mental health conditions (depression, anxiety, and chronic pain), pulmonary diseases (COPD, asthma, and chronic bronchitis), musculoskeletal diseases (osteoarthritis, arthritis, osteoporosis, and other musculoskeletal conditions), and musculo-pulmonary conditions (osteoporosis, arthritis, osteoarthritis, and chronic bronchitis). Epidemiologically, multimorbidity is poorly understood (Calderon-Larranaga et al., 2017; Navickas, Petric, Feigl & Seychell, 2016); however, results from the current study suggest that the onset of a chronic disease (e.g., chronic bronchitis) leads to system-specific deficits. This may render a system susceptible to the development of a second or third similar disease in the same system (e.g., COPD), rather than a unique disease in a separate system.

MCA also highlighted cross-dimensional associations between chronic bronchitis and musculoskeletal diseases. These findings support previous data, which suggest pulmonary and musculoskeletal comorbidities frequently co-occur (Pruchno et al., 2016). This may imply similar pathophysiology between these two disease types, such that the development of one type

of condition increases the likelihood of developing the other. Overlapping risk factors, such as tobacco use, age, inflammation (local and systemic), physical inactivity, and long-term use of corticosteroids (Cielen, Maes & Gayan-Ramirez, 2014), may be implicated in these findings. Longstanding systemic inflammation may increase susceptibility to the development of both disease types. The use of corticosteroids, a common treatment for both musculoskeletal and pulmonary inflammation, may further render each system vulnerable to comorbid disease development (Park, Man & Sin, 2012).

Contrary to established data highlighting chronic pain as an outcome associated with chronic disease progression, self-reported chronic pain was not associated with the pulmonary or musculoskeletal dimensions in the current sample. This finding is particularly interesting given that pain is a cardinal symptom in musculoskeletal conditions such as arthritis, osteoarthritis, and rheumatoid arthritis (Woolf & Pfleger, 2003). Estimates also suggest that chronic pain is more prevalent among pulmonary patients when compared to similar-aged healthy cohorts (Lee et al., 2017). Findings in the current study become clearer when considering the significant endorsement of anxiety and depression among this sample (42% and 49% of the sample, respectively). A plethora of data underscore the associations among depression, anxiety, and chronic pain among older adults (Surah et al., 2014; Reid et al., 2015; Zis et al., 2017). It may be that the comorbidities between pain, depression and anxiety supersede the potential dimensional relationships with other disease categories. Therefore, patients with chronic pain may be significantly more likely to experience comorbid mental health conditions than pulmonary or musculoskeletal diseases. It may be further plausible that these findings are reflective of disease progression. While pain is a cardinal symptom of musculoskeletal disorders at all stages (Murphy, Schepens Niemiec, Lyden & Kratz, 2016), pulmonary pain arises more frequently in

advanced staging (Reid et al., 2015). Disease staging with not assessed within this community-dwelling sample of older adults; however, the possibility remains that participants in this sample are in the earlier stages of pulmonary and/or musculoskeletal diseases, and as such, the incidence of pain associated with these diseases may be minimal.

Depressive Symptom Severity, Pain Interference, and Physical Functioning

Analyses identified the mental health, pulmonary, and musculoskeletal dimensions as latent constructs that influence depressive symptom severity, as measured by the Geriatric Depression Scale (GDS). Analyses also indicated associations between the mental health and musculoskeletal dimensions and pain interference, as measured by the Brief Pain Inventory (BPI). Physical functioning was significantly associated with both outcomes.

For ease of comprehension, the following sections will discuss findings as they relate to depressive and pain outcomes. All references to "chronic pain" will refer to the reported history of pain, while "pain interference" refers to the interference score as measured by the BPI. Equally, "self-reported" depression refers to the endorsement of a previous depression diagnosis, while "depressive symptom severity" refers to the score as measured by the GDS.

Depressive symptom severity. The mental health, musculoskeletal, and pulmonary dimensions, as well as physical functioning and race, were associated with depressive symptom severity. The mental health cluster (i.e., self-reported diagnosis of depression, anxiety, and chronic pain) was most significantly predictive of depressive symptom severity. These findings are consistent with existing literature suggesting that, like physical health conditions, mental health disorders frequently occur comorbidly (Al-Asadi, Klein & Meyer, 2015). The present study suggests that individuals with pre-existing mental health disorders are more susceptible to increased depressive symptoms.

The grouping of reported depression and pain in the current study may also reflect the circuitous relationship between these two constructs. As noted, the majority of the current sample reported a history of chronic pain (see Table 2). While chronic pain is largely considered a somatic disorder, it has significant mental health ramifications (Zis et al., 2017). Prospective studies have cited depression as a direct consequence of pain (Chou, 2007). Among community-dwelling older adults, depressive symptoms often develop secondary to poor perceptions of pain control and maladaptive coping strategies (Chou, 2007; Denkinger et al., 2014). Depression then leads to increased pain symptoms, with heightened awareness of painful stimuli, pain catastrophizing, and fear avoidance (Arola et al., 2010), all of which are simultaneously depressive risk factors. It is possible that the self-report of chronic pain alone, coupled with the cyclical nature of the pain-depression dyad, is contributing the observed outcome between the mental health cluster and depressive symptom severity.

Musculoskeletal conditions (e.g., arthritis, osteoarthritis) were associated with increased depressive symptoms. Disease characteristics such as decreased physical functioning, strength degradation, and immobility likely contribute to these findings (Quach & Burr, 2018). Pain may underlie these characteristics, which is supported by the overwhelming self-report of chronic pain in this sample. While the causal factor of chronic pain in this sample is unknown, moderate-to-severe constant pain is reported among 90% of those with musculoskeletal disorders (Silva, Alvarelhao, Queiros & Rocha, 2013). Pain impedes the ability to complete tasks and contributes to poor physical functioning, social isolation, and decreased quality of life among older adults (Arola et al., 2010), all of which are depressive risk factors. The symptom profile associated with musculoskeletal disorders often impacts successful aging, and older adults may express frustration with physical limitations secondary to disease progression. Social comparisons with

younger or healthier cohorts may further contribute to depressive severity, as functional shortcomings may be emphasized. Lastly, a difficulty coping with disease progression may influence these findings. Older adults may experience grief associated with disease progression (Jackson, 2014), as losses may be considerate (e.g., loss of independence, autonomy, financial security). The observed finding between the musculoskeletal cluster and depressive symptomatology is likely multifactorial, strengthened by the symptom expression associated with these disorders.

Pulmonary conditions were also positively associated with depressive symptomatology in this sample of older adults. Broadly, mental health conditions are reported more frequently among patients with pulmonary conditions (e.g., COPD) than those with other chronic conditions (e.g., cancers, hypertension, diabetes; Yohannes, Kaplan & Hanania, 2018). Present findings support existing literature and highlight potentially unmet mental health needs among those with pulmonary conditions. This may be due, in part, to difficulty accepting and coping with disease progression. Pulmonary disease courses are marked by dyspnea, reduced lung functioning, and decrease in physical functioning (Stockley, 2009; Yohannes et al., 2018). Secondary to the disease course, patients often report social isolation, increased hopelessness, and future oriented fear – all of which are mental health risk factors (Yohannes et al., 2018). Mental health needs may arise given the burden associated with pulmonary disorders in addition to difficulty coping with symptom expression. This may imply that those with pulmonary conditions are at a significantly increased risk for depressive symptoms and highlight potential areas for mental health intervention.

Results also indicated positive associations between depressive symptom severity and total functional disability, which may underscore the aforementioned findings. Chronic health

conditions such as arthritis, cancers, diabetes, and cardiovascular disease are associated with increased risk for depression and disability (Murphy et al., 2016). Available data emphasize the bidirectional nature of this relationship, in which depression predicts disability trajectories above and beyond other risk factors, such as age, race, socioeconomic status, education, tobacco use, alcohol consumption, and disease condition (Murphy et al., 2016).

Findings from the present study support the relationship between functional abilities and depressive symptom severity. This is further notable given the overall low depressive symptom severity among this sample (as measured by the GDS), thus emphasizing the strength of this relationship. Compared to population norms, this sample reported a high level of functional impairment across all domains. While this sample is composed of independently-living older adults, these findings clearly reflect difficulty with mobility, completing self-care activities, and engaging in society (as measured by the WHODAS 2.0). Independent-living can become challenging due to physical limitations and worsening health (Ahlqvist, Nyfors & Suhonen, 2016); depressive symptom severity among this sample may reflect physical outcomes associated with multimorbidities.

It is difficult to tease apart the exact nature of the associations among chronic pain, depressive symptoms, and physical functioning, particularly among this sample. Pain and physical limitations are broadly associated with most chronic conditions analyzed in this study. The interaction among depressive symptoms, pain, and physical functioning may be cyclical, the direction of which is unclear. Wang and colleagues (2015) found functional disability mediated the relationship between pain and depression among older adults with musculoskeletal diseases (Wang, Jayasuriya, Man & Fu, 2015). Others have cited pain as the mediating variable between depression and physical functioning (Wang et al., 2015). It is possible that pain contributes to

decreased physical functioning, which subsequently leads to depressive symptoms associated with these disease clusters. However, it is equally plausible that depressive symptoms exacerbate pain, an outcome of which is poor physical functioning. Among this sample, it is impossible to discern the directionality of this relationship. However, the observed relationships between disease clusters and depressive symptom severity is undoubtedly governed, at least in part, by self-reported chronic pain and low physical functioning.

Depressive symptom severity and pain interference demonstrated reciprocal insignificant relationships. It may be that the mental health cluster, which included the self-reported diagnoses of depression and chronic pain, led to issues with multicollinearity thus masking the significance between these variables. An additional hypothesis posits that the low scores for each condition, as measured by the GDS and the BPI respectively, account for the insignificance. Participants in this sample reported clinically subthreshold levels of both depression and pain, and as such relationships between these two variables may be null.

Numerous psychosocial factors (i.e., social support, education, marital status, income, and age) were insignificantly associated with depressive symptom severity. This is largely inconsistent with available literature, which broadly demonstrates relationships among psychosocial factors and depression in older adults. The sociodemographic composition of this sample may otherwise explain this insignificance. This sample was fairly homogenous, with the majority reporting high educational attainment, sufficient monthly income, and social support across multiple domains. Participants endorsed access to resources, perhaps secondary to financial security, which may promote positive healthy aging. Participants may be receiving current mental health treatment, such as psychotherapy or psychotropic medications, subsequently contributing to the minimal rates of depressive symptoms. These cumulative social

determinants serve as a protective factor against mental health conditions, such as depression, and may justify the otherwise insignificant findings observed in this study.

Pain interference. The mental health and musculoskeletal dimensions, as well as physical functioning and age, were predictive of pain interference. Findings pertaining to the mental health cluster may be partially explained by the prevalence of self-reported chronic pain among this sample, in which those with longstanding chronic pain experience higher pain interference. However, the demonstrated associations also lend credit to the bidirectional relationship between pain and mental health. Anxiety in particular is implicated in pain interference and likely mediates cognitive pain constructs, such as hypervigilance and catastrophizing, among older adults (Woo, 2010). Pain hypervigilance is defined as a heightened awareness and difficulty distracting oneself from pain (Woo, 2010). Catastrophizing is a concept associated with believing the worst outcome is the most likely (Woo, 2010); this often implies poor perceived pain control, amplified theoretical pain, and an irrational belief in negative health outcomes (Poulin et al., 2016). Engaging cognitive coping strategies for pain (such as distraction and reappraisal) requires substantial cognitive resources. In the context of depression and anxiety, baseline cognitive resources are diminished; in the setting of comorbid chronic pain, these resources may be minimal. Comorbid mental health conditions, such as the reported history of anxiety in this sample, likely impact the efficacy of pain coping strategies (Arola et al., 2010), and may contribute to increased pain interference.

The musculoskeletal dimension was also associated with pain interference among this sample. Among musculoskeletal disorders, pain interference likely reflects difficulty with physical functioning (Arola et al., 2010). For example, individuals with arthritic pain describe difficulties engaging in life activities, such as physical activity, social engagements, and

activities they once considered pleasurable (Ryan & McGuire, 2016). As a function of these diseases, pain often arises with movement, often resulting in significant physical limitations. Musculoskeletal pain may be implicated in activity avoidance (Petursdottir, Arnadottir & Halldorsdottir, 2010) and thus related to pain interference among older adults.

Interestingly, the pulmonary dimension was not associated with pain interference, a finding that is inconsistent with recent literature. Pain is considered a prevalent symptom among patients with pulmonary disorders, most notably COPD (van Dam van Isselt et al., 2014). Given that, and coupled with dyspneic pain (Harrison et al., 2017), it would be expected that pain interference scores would be associated with the pulmonary cluster. Potential hypotheses pertain to the size and composition of the study sample. The pulmonary cluster was largely composed of asthma and chronic bronchitis; a small percentage of individuals endorsed a COPD diagnosis. These findings may suggest that pain interference associated with non-obstructive pulmonary diseases is minimal. Moreover, pain interference may be correlated with pulmonary disease progression, with progression mitigating pain. As asthma and chronic bronchitis are often precursors to COPD (Wirtz, 2005), it is possible that they do not yet meet the pain threshold. However, in the absence of information pertaining to disease stages, it is difficult to speculate on the significance of these findings. Limited data has assessed pain among early pulmonary diseases (van Dam van Isselt et al., 2014). Even fewer studies assess the degree of pain and pain interference among older adults with solely asthma and/or chronic bronchitis. As such, additional research is warranted to assess the degree of pain interference among non-obstructive pulmonary disorders.

Lastly, functional disability was significantly predictive of pain interference in this sample. An amalgam of data underscores functional disability as a significant predictor of pain

interference among older adults (Przekop et al., 2015). Longstanding chronic pain and multimorbidity symptom expression may underlie issues with physical functioning in this sample. Further, the observed relationship between pain interference and functional impairment may be cyclical and support the fear-avoidance pain model (Baker et al., 2016). In the presence of pain, avoidance strategies are implemented to mitigate pain. These often extend to activities such as exercise, which subsequently contribute to muscle atrophy and physical disability, which increases overall pain. The outcome is higher degrees of pain interference, as pain is perceived to interfere in all aspects of daily living. While impossible to ascertain the causal nature of these relationships, the current project demonstrates the circuitous nature of pain and physical functioning.

Younger age was interestingly associated with increased pain interference, a finding which supports recent literature (Boggero, Geiger, Segerstrom & Carlson, 2015). Despite significant pain, older adults report higher qualities of life, satisfaction with social support, and better mood when compared with younger cohorts (Boggero et al., 2015). Findings in the present study suggest that older age is associated with more positive psychological well-being. Older adults may have established greater coping mechanisms, channels of support, and sought out treatment to aid with pain, thus contributing to psychological well-being. Pain acceptance may also be high among this sample, substantiating the lower levels of emotional distress and higher psychosocial functioning (Kratz, Ehde, Bombardier, Kalpakjian & Hanks, 2017). Older age may then be indicative of greater psychological well-being and pain acceptance, thus supporting the present findings.

Marital status, income, sex, race, education, and social support were insignificantly predictive of pain interference, findings of which are inconsistent with available literature. This

may be reflective of social determinants of health among this sample of older adults. High education, significant social support, and financial stability are protective factors against pain, and may substantiate the insignificant relationships. It may be likely that participants are undergoing treatment for pain management in the setting of their chronic illnesses, and are thus experiencing relatively low pain interference, rendering these null relationships. These findings may be reflective of positive psychosocial impacts mediating the impact of pain interference.

Clinical Implications

Findings from the present project may have several clinical implications. While the prevalence of multimorbidities is widely acknowledged, clinical practices have yet to incorporate these into in models of care (Kane, 2000, 2005). To date, clinical gold standards have emphasized single-orientation practices (Dawes, 2010). Practice standards are largely developed from randomized control trials that exclude participants with multimorbidities (Bierman & Tinetti, 2016). Current clinical guidelines advocate a "one size fits all" model, emphasizing a single disease orientation, rather than an inclusive framework for care (Dawes, 2010). These standards lack clear guidance for multiple disease management (Bierman & Tinetti, 2016). Clinical care still largely occurs in silos, with insufficient communication across disciplines. These details are troublesome, as standard care for one disease may be contraindicated for a co-occurring condition. This is further problematic in light of the current results, which emphasize the necessary inclusion of biopsychosocial factors in conceptualizing health.

While the recognition of multimorbidities is growing, considerable growth still remains to provide consistent and quality care. Personalized medicine is required, with emphases on quality of life, goals of care, simplification of treatment regimens, and integrated health care (Bierman & Tinetti, 2016). Given the demonstrated associations between multimorbidity and

depressive symptoms, mental health services are a necessary inclusion in the treatment planning for older adults. Further, incorporating models of multimorbidity into clinical care may lead to a better understanding of disease interactions among older adults with positive health outcomes. Medical professionals should strive for cross-specialty communication and the development of individual treatment regimens that incorporate best practices for each condition. This may involve shunning typical "gold-standard" treatment guidelines in favor of those with higher qualities of life. Creativity may be necessary to establish goals of care that best encapsulate multimorbidities. Lastly, clinicians should strive to gain a better understanding of the aging process, to improve the conceptualization of multimorbidities in older adults.

While current models of primary care emphasize screening for the presence of depressive symptoms (Ng, How, & Ng, 2017), few clinicians are trained to detect these symptoms in older adults. Medical professionals may be unable to correctly differentiate the source of somatic symptoms (e.g., those that originate due to a mental health condition versus those that arise in the setting of a physical disease). This may lead to potential issues with diagnosis (over, under, and misdiagnosis). Depressive symptoms may be misattributed to the aging process or an ongoing medical issue (Nutting, Rost, Smith, Werner, & Elliot, 2000), and ineffectively treated. In a primary care setting, depressive and pain symptoms compete with other medical concerns, and may be overlooked given physician time constraints (Nutting et al., 2000). Mood and pain symptoms often fall behind more subjectively pressing needs, such as medication adjustments, changes in medical symptomatology, and/or onset of new conditions. This is further impacted by the significant shortage of geriatricians (physicians specifically trained to treat older adults; Olivero, 2015), who may be better versed in the detection and treatment of these conditions among older adults. As such, pain and depression often go undertreated given shortcomings in

the medical system. Findings from this project underscore the impact of multimorbidities on mental health and highlight the increased prevalence of depression in the context of physical conditions. The presence of mental health professionals in clinical care settings may best address these unmet needs among older adults.

In settings without mental health providers, a brief assessment of perceived functional impairment may help identify those at greatest risk for depression and/or negative pain-related outcomes. Assessment of functional status may also help identify those in need of services, whether it be mental health, financial, social, or physical. A greater awareness of the relationships among these variables may lead to better methods of assessment, more comprehensive care, and better treatment of these conditions.

Strengths, Limitations, and Future Directions

This study was the first to implement MCA to cluster disease categories by body system in an older adult community-dwelling sample. This project is further unique in the utility of the BPI, MSPSS, WHODAS 2.0 and GDS in a single study design. Findings from this project support the theoretical clustering by body system and may implicate latent systemic deficits that contribute to the likelihood of developing similar chronic conditions.

Anxiety symptomatology was not measured in the context of this study. It was determined that, in addition to increased response burden, an anxiety measure may lead to multicollinearity with the depression measure. Estimates indicate that roughly 60% of those endorsing anxiety symptoms will simultaneously report depressive symptoms (National Alliance on Mental Illness, 2018), supporting the significant comorbid relationships between anxiety and depression. Given that, the depression measure was deemed sufficient to encapsulate the mental health symptomatology in this study. However, future research may benefit from the inclusion of

an anxiety measure to assess the potential relationships between multimorbidity, pain, and depression. The inclusion may better define the comorbid relationship between anxiety and depression among older adults. An anxiety measure may also clarify the impact of anxiety symptomatology on the report and expression of chronic pain in an older adult sample. Further studies may investigate anxiety as an outcome (similar to depressive symptom severity in this study), and the potential role as a moderating variable between multimorbidity and pain interference.

The present findings are limited by the sample size (*N*=57) which precluded analysis of the potential moderating influence of pain inference on the observed relationships between disease clusters and depressive symptomatology. Thus, latent relationships may be masked secondary to low sample size. Future studies would benefit from increased sample size, which may highlight relationships not readily apparent from the current data. With sufficient sample size, a confirmatory factor analysis may be warranted to better test the hypothesis that diseases cluster according to body system. However, despite the small sample size, findings from this project support the clustering of diseases by body system, thus furthering the understanding of multimorbidities among older adults.

This study utilized a cross-sectional design; disease diagnoses were gathered via self-report, and no further medical tests or documentation were required to confirm diagnoses. Self-report data is susceptible to report bias, such as social desirability, and may thus limit external validity (Rosenman, Tennekoon & Hill, 2011). Participants were not asked to quantify disease staging, nor were they asked after the severity and progression of their conditions. Given that, no causal relationships can be inferred from this study sample, and it is impossible to determine the processes by which multimorbidities arose in this sample. However, the associations

demonstrated in this project lend credit to the mechanisms implicated in disease development and warrant further investigation.

Additionally, as a function of the area in which data was collected, the sample is very homogenous, and as such cannot be generalized to more diverse samples or populations. Nearly all participants identified as White, and as such comparisons across racial/ethnic groups are impossible to discern. It is difficult to ascertain whether the observed relationship between race and depressive symptom severity is meaningful, or whether this is merely reflective of the homogenous sample. Further, findings may not be fully representative of the Douglas County region and may simply reflect those with greater access to resources who are predisposed to participate in research studies such as this. It is suggested that future studies pursue greater diversity (racial/ethnic, SES, educational attainment) to greater understand the social determinants that may influence and impact physical and mental health.

Conclusion

Multimorbidity is pervasive among older adults. Significant associations have been demonstrated between multimorbidity, depression, and pain. However, despite the superfluity of data highlighting these relationships, limited research has described the triadic relationship among these constructs. The present study incorporated both depression and pain interference into the conceptualization of multimorbidity. Findings suggest that chronic diseases may cluster according to body system, which may be representative of latent deficits in a system that increase the likelihood of developing similar chronic conditions. Body systems and psychosocial factors, such as race and functional impairment, were further associated with depressive symptom severity and pain interference. Analyses support the necessary inclusion of the psychosocial factors, suggesting that depressive symptom severity and pain interference cannot be fully

explained by the disease categories alone. Rather, the psychosocial factors are essential components which contribute to observed states of health and must be accounted for in the conceptualization of depression and pain.

The current study contributes to the growing field investigating multimorbidities among older adults. This study is unique in that it investigates the numerous biopsychosocial components (e.g., depression, chronic pain) that compound the effects of multimorbidities and impact quality of life. Given the limited understanding regarding patterning of disease clusters, findings from this study may help to identify common groupings among older adults. In particular, conditions from the mental health, pulmonary, and musculoskeletal domains may commonly co-occur, which may have significant implications to disease prevention and treatment. Further, these findings underscore the multifaceted relationship among biopsychosocial components of health and emphasize the necessary inclusion of these factors when conceptualizing health among older adults.

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Appendix A

Recruitment flyer

Do you have a chronic illness?

The researchers at the University of Kansas need your help. Adults age 55 and older with at least **2+ chronic conditions** are needed for a study looking at health outcomes of having multiple chronic illnesses.

Participants will be asked to complete a brief interview (about 20 minutes) regarding health.

For further information on this study and how you can participate, please contact:

Jacquelyn Minahan, M.A.
University of Kansas
Department of Psychology
jminahan@ku.edu
(785) 864 – 1268 or (785) 864 – 6528

This research study has been approved by the Institutional Review Board.

Redefining Multimorbidities in Older Adults

What is this study about?

This goal of this study is to better understand chronic illnesses among older adults (e.g., arthritis, hypertension, diabetes, cancer, etc.). Research shows that having 2 or more chronic conditions is very common among adults 65 years and older. This study aims to look at the relationships between chronic conditions and their impact on health. We will ask questions about your health, the types of chronic conditions you have, and how you have coped with these diseases. We will also ask you about your social support, your access to health care, and whether or not you experience any pain.

What does my participation require?

All that would be required is a 20-minute interview (either by phone or in-person). If you decide to do an in-person interview, all interviews will be conducted in Fraser Hall on the University of Kansas campus. If you decide to participate by phone, we will call you at a time of your choosing. There is no intervention involved in this project.

What happens to my information?

Your information is kept completely confidential, in compliance with federal laws. To ensure your confidentiality, any information that links you to this study will be kept in a secured and locked area in our research office at the University of Kansas. Only the principal investigator and trained research staff will have access to this information.

Appendix B

Recruitment letter

Date _____

Dear _____,

You have been selected to take part in an exciting new research study that focuses on the health of older adults in Douglas County. The goal of this project is to better understand chronic illnesses among older adults (such as arthritis, hypertension, diabetes, etc.), particularly for those with 2 or more chronic conditions.

We are now in the early stages of the project and request, and we greatly appreciate your participation in this project!

By participating in this project, you will be contributing to the increasing knowledge of what we know about chronic illnesses among older adults. Older adults, particularly those with multiple chronic illnesses, have been either minimally represented or completely excluded from research regarding health. A member of our research team will call as an initial introduction to this study, and to answer any questions you may have about the project.

We ask that you take a few minutes to read the information sheet included in this packet. This sheet will provide instructions on what you have to do to participate in this project. Someone from our team will contact you shortly.

If you have any questions, please feel free to contact us at (785) 864-1268 or at healthoutcomes@ku.edu.

THANK YOU for your participation, and we look forward to speaking with you very soon!

Sincerely,

Jacquelyn Minahan, M.A.
Principal Investigator

Tamara Baker, Ph.D.
Faculty Supervisor

This project is endorsed and supported by the Senior Resource Center for Douglas County.

Redefining Multimorbidities in Older Adults

What is this study about?

This goal of this study is to better understand chronic illnesses among older adults (e.g., arthritis, hypertension, diabetes, cancer, etc.). Research shows that having 2 or more chronic conditions is very common among adults 65 years and older. This study aims to look at the relationships between chronic conditions and their impact on health. We will ask questions about your health, the types of chronic conditions you have, and how you have coped with these diseases. We will also ask you about your social support, your access to health care, and whether or not you experience any pain.

What does my participation require?

All that would be required is a 20 minute interview (either by phone or in-person). If you decide to do an in-person interview, all interviews will be conducted in Fraser Hall on the University of Kansas campus. If you decide to participate by phone, we will call you at a time of your choosing. There is no intervention involved in this project.

What happens to my information?

Your information is kept completely confidential, in compliance with federal laws. To ensure your confidentiality, any information that links you to this study will be kept in a secured and locked area in our research office at the University of Kansas. Only the principal investigator and trained research staff will have access to this information.

Appendix C

Written Consent Form

Department of Psychology
426 Fraser Hall · 1415 Jayhawk Blvd
University of Kansas · Lawrence, KS 66045
Phone: 785-864-4131 · Fax: 785-864-5696

Informed Consent Statement

Researchers at the University of Kansas (KU) study many topics. To do this, we need the help of people who agree to take part in a research study called:

Redefining Multimorbidities in Older Adults: Chronic Illnesses, Depression, and Chronic Pain

The person who is in charge of this research study is **Jacquelyn Minahan**. This person is called the Principal Investigator. However, other research staff may be involved and can act on behalf of the person in charge. The person explaining the research to you may be someone other than the Principal Investigator.

KEY INFORMATION

- Your participation in this research project is completely voluntary.
- Your participation will take about 20 minutes.
- You will be asked to do the following procedures: complete an interview asking after your physical and mental health, access to health care, and social support. More detailed information on the procedures can be found below.
- This study presents little to no risk to the participant.
- The benefit of participating is to help researchers better understand the relationships between chronic illnesses, pain, and mental health.
- Your alternative to participating in this research study is not to participate.

INTRODUCTION

The Department of Psychology at the University of Kansas supports the practice of protection for human subjects participating in research. The following information is provided for you to decide whether you wish to participate in the present study. You may refuse to sign this form and not participate in this study. You should be aware that even if you agree to participate, you are free to withdraw at any time. If you do withdraw from this study, it will not affect your relationship with this unit, the services it may provide to you, or the University of Kansas.

PURPOSE OF THE STUDY

The purpose of this study is to understand the relationships between chronic illnesses (e.g., diabetes, hypertension, cancers), chronic pain, and depression. The long-term goals of this projects are: 1) to understand the mechanisms of disease clustering among older adults, 2) to understand the relationships between disease clusters, pain interference, and depression, and 3) to investigate the degree to which socio-demographic characteristics (e.g., age, race/ethnicity, education, marital status, financial status, access to health care, and social support) influence the relationships between disease clusters, pain interference, and depression. This is important as the research suggests an association among these variables. Yet, with this information, very little is known about the strength and direction of these relationships, particularly among older adults, which is the reasoning for conducting this project.

PROCEDURES

You will be asked to complete an interview (either in-person or via phone) assessing physical and mental health, access to health care, and social support. These questions may be considered sensitive in nature. These questions ask about depression, prevalence of chronic illnesses, and chronic pain. All responses to these questions will be kept confidential and de-identified (your name will not be included on the interview). The interview should take about 20 minutes. This study does not include an intervention.

RISKS

This study presents little or no risk to the participant. The procedures involved in the proposed project will measure mental and physical health, social support, and access to health care among older adults. Specific areas that participants will be asked include: chronic illnesses, depression, pain, functional status, and perceptions of social support.

Assessing these characteristics is not expected to produce any undue distress.

If you feel any distress while completing the interview, please feel free to skip any of the questions or stop. You can also talk to a research assistant if you have any questions. The research assistant will be trained to answer any questions and address possible situations while completing the project. Further mental health resources have been provided at the end of this consent form.

Confidentiality will be protected, and all information will de-identified.

If you have any of these problems, call the person in charge of this study right away at 785-864-6528.

BENEFITS

The benefits of the proposed project outweigh the minimal risks involved in participation. This study will provide a better understanding of the relationships between chronic illnesses, pain,

and depression. Similarly, it may provide a mechanism for personal reflection of your own personal physical and mental health.

PAYMENT TO PARTICIPANTS
You will not be paid for participating in this study.

PARTICIPANT CONFIDENTIALITY
We must keep your study records as confidential as possible. There are federal laws that say we must keep your study records private. To ensure complete discretion, the signed consent forms (and interviews), with your name and participant ID number, will be kept in a secured and locked area in the research office. Only the principal investigator and trained research staff will have access to this information. No discussion of you will take place in public areas (e.g., patient waiting areas). Every effort will be taken to preserve your privacy, anonymity, and confidentiality.

However, certain people may need to see your study records. By law, anyone who looks at your records must keep them completely confidential. The only people who will be allowed to see these records are:

- The research team, including the Principal Investigator, study coordinator, and all other research staff.
- Certain government and university people who need to know more about the study. For example, individuals who provide oversight on this study may need to look at your records. These include the University of Kansas' institutional Review Board (IRB) and the staff that work for the IRB. Other individuals who work for the University of Kansas that provide other kinds of oversight may also need to look at your records.

We may publish what we learn from this study. If we do, we will not let anyone know your name. We will not publish anything else that would let people know who you are.

Furthermore, no names or other identifying information will be directly linked to the completed interview. Each participant will receive a subject code #, which will be assigned to them prior to completing the interview (or participating in the study). Only the subject # will be on the completed measure. Each participant will be reassured that no information provided on the interview will be directly linked to his/her identity.

Permission granted on this date to use and disclose your information remains in effect indefinitely. By signing this form you give permission for the use and disclosure of your information for purposes of this study at any time in the future.

REFUSAL TO SIGN CONSENT AND AUTHORIZATION
You are not required to sign this Consent and Authorization form and you may refuse to do so without affecting your right to any services you are receiving or may receive from the University of Kansas or to participate in any programs or events of the University of Kansas. However, if you refuse to sign, you cannot participate in this study.

VOLUNTARY PARTICIPATION / WITHDRAWAL

You should only take part in this study if you want to volunteer. You should not feel that there is any pressure to take part in the study, to please the investigator or the research staff. You are free to participate in this research or withdraw at any time. There will be no penalty or loss of benefits you are entitled to receive if you stop taking part in this study. You also have the right to cancel your permission to use and disclose further information collected about you, in writing, at any time, by sending your written request to: Jacquelyn Minahan, 1415 Jayhawk Blvd., 426 Fraser Hall, Lawrence, KS 66045.

If you cancel permission to use your information, the researchers will stop collecting additional information about you. However, the research team may use and disclose information that was gathered before they received your cancellation, as described above.

QUESTIONS ABOUT PARTICIPATION

Questions about procedures should be directed to the researcher(s) listed at the end of this consent form or to the Human Research Protection Program (irb@ku.edu or (785) 864-7429 ext. 1 or 2385 Irving Hill Road, Lawrence, KS 66045-7568.

PARTICIPANT CERTIFICATION FOR WRITTEN CONSENT:

I have read this Consent and Authorization form. I have had the opportunity to ask, and I have received answers to, any questions I had regarding the study. I understand that if I have any additional questions about my rights as a research participant, I may call (785) 864-7429 or (785) 864-7385, write the Human Research Protection Program (HRPP), University of Kansas, 2385 Irving Hill Road, Lawrence, Kansas 66045-7568, or email irb@ku.edu.

I agree to take part in this study as a research participant. By my signature I affirm that I am at least 18 years old and that I have received a copy of this Consent and Authorization form.

_____ _____

Printed Name of Participant Date

_____

Participant's Signature

Researcher Contact Information

Jacquelyn Minahan, M.A.
Principal Investigator
Psychology Department
426 Fraser Hall

Tamara A. Baker, Ph.D.
Faculty Supervisor
Psychology Department
426 Fraser Hall

University of Kansas
Lawrence, KS 66045
(785) 864 – 4131

University of Kansas
Lawrence, KS 66045
(785) 864 – 6528

Oral Consent Script

As a graduate student in the University of Kansas's Department of Psychology, I am conducting a research project about physical and mental health in older adults. I would like to interview you to obtain your views on chronic illnesses, depression, and pain. Your participation is expected to take about 20 minutes. You have no obligation to participate and you may discontinue your involvement at any time.

Your participation should cause no more discomfort than you would experience in your everyday life. Although participation may not benefit you directly, the information obtained from the study will help us gain a better understanding of relationships between chronic illnesses, pain, and depression. Similarly, it may provide a mechanism for personal reflection of your own personal physical and mental health. Your identifiable information will not be shared unless (a) it is required by law or university policy, or (b) you give written permission.

Participation in the interview indicates your willingness to take part in this study and that you are at least 18 years old. Should you have any questions about this project or your participation in it you may ask me or my faculty supervisor, Dr. Tamara Baker, in the Department of Psychology. If you have any questions about your rights as a research participant, you may call the Human Research Protection Program at (785) 864-7429 or email irb@ku.edu.

Appendix D

Survey Measures

Chronic conditions

Has a doctor, nurse, or other health professional ever told you that you had any of the following? Please check all that apply.

- ☐ Cardiovascular disease
- ☐ Congestive heart failure (CHF)
- ☐ Hypertension
- ☐ Coronary heart disease/coronary artery disease/ischemic heart disease
- ☐ Respiratory disease
- ☐ Chronic obstructive pulmonary disease (COPD)
- ☐ Asthma
- ☐ Chronic bronchitis
- ☐ Mental health disorders
- ☐ Depression
- ☐ Anxiety
- ☐ Chronic pain
- ☐ Diabetes
- ☐ Metabolic disorder (excluding diabetes)
- ☐ Musculoskeletal disease
- ☐ Arthritis
- ☐ Osteoarthritis
- ☐ Rheumatoid arthritis
- ☐ Osteoporosis
- ☐ Other auto-immune disorder
- ☐ Cancer
- ☐ Prostate cancer
- ☐ Breast cancer
- ☐ Lung cancer
- ☐ Stomach cancer
- ☐ Colon cancer
- ☐ Chronic kidney disease

Brief Pain Inventory

2) Have you ever had pain due to your present disease?

☐ Yes ☐ No ☐ Uncertain

3) When you first received your diagnosis, was pain one of your symptoms?

☐ Yes ☐ No ☐ Uncertain

4) Have you had surgery in the past month?

☐ Yes ☐ No

If yes, what kind? _____

5) Throughout our lives, most of us have had pain from time to time (such as minor headaches, sprains, toothaches). Have you had pain **other** than these everyday kinds of pain during the **last week**?

☐ Yes ☐ No

5a) Did you take pain medication in the last 7 days?

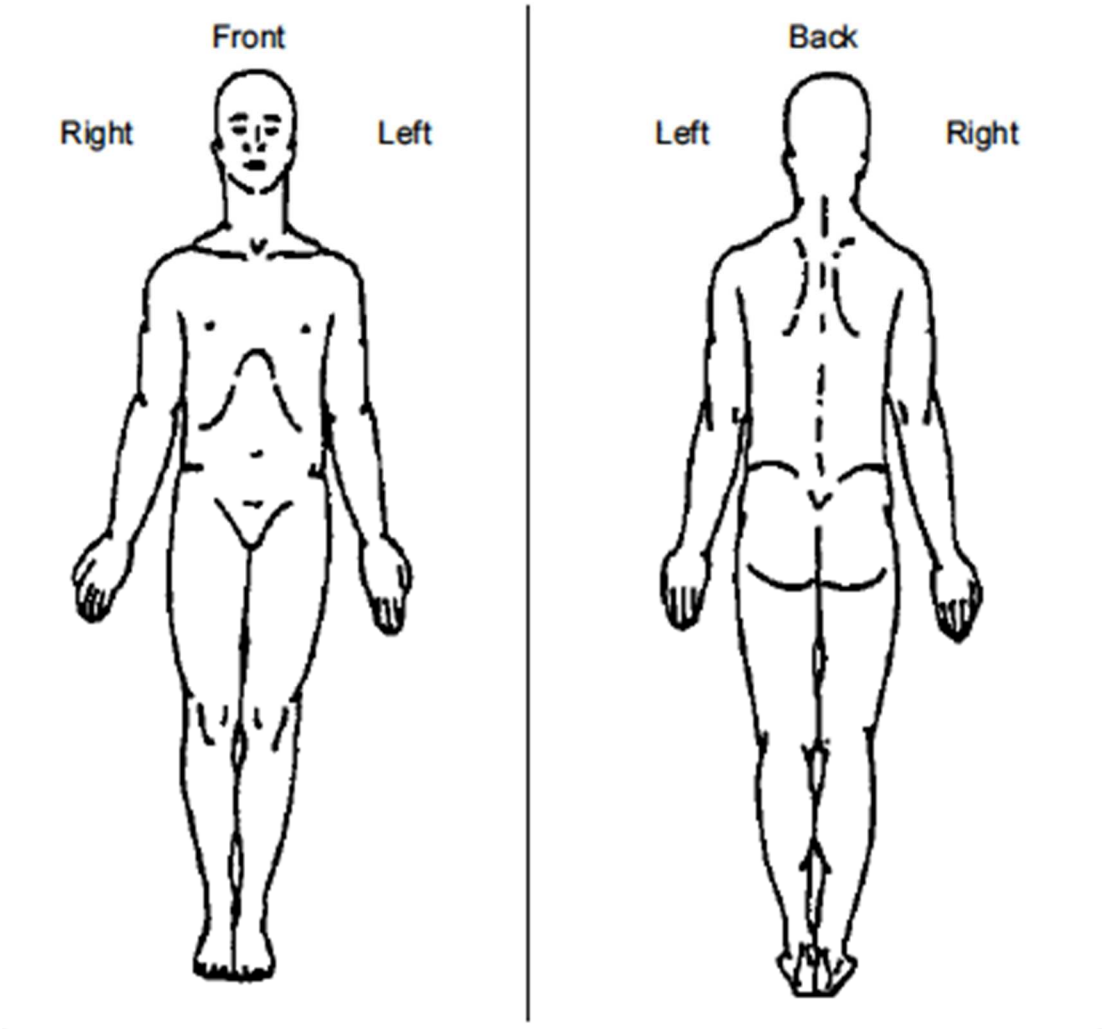
☐ Yes ☐ No

5b) I feel I have some form of pain now that requires pain each and every day.

☐ Yes ☐ No

IF YOUR ANSWERS TO 5, 5A, AND 5B WERE **ALL NO**, PLEASE STOP HERE AND GO TO THE NEXT SECTION.

IF ANY OF YOUR ANSWERS TO 5, 5A, AND 5B WERE **YES**, PLEASE CONTINUE.



6) Please rate your pain by circling the one number that best describes your pain at its **worst** in the last week.

0	1	2	3	4	5	6	7	8	9	10
No pain										Pain as bad as you can imagine

7) Please rate your pain by circling the one number that best describes your pain at its **least** in the last week.

0	1	2	3	4	5	6	7	8	9	10
No pain										

Pain as bad as you can imagine

8) Please rate you rpain by circling the one number that best describes your pain on the **average**.

0	1	2	3	4	5	6	7	8	9	10
No pain										Pain as bad as you can imagine

9) Please rate yur pain by circling the one number that tells how much pain you have **right now**.

0	1	2	3	4	5	6	7	8	9	10
No pain										Pain as bad as you can imagine

10) What kinds of things make your pain feel better (for example, heat, medicine, rest)?

---

11) What kinds of things make your pain worse (for example, walking, standing, lifting)?

---

12) What treatments or medications are you receiving for pain?

---

13) In the last week, how much relief have pain treatments or medications provided? Please circle the one percentage that shows how much relief you have received.

0%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
No Relief										Complete Relief

14) If you take pain medication, how many hours does it take before the pain returns?

- ☐ Pain medication doesn't help at all
- ☐ One hour
- ☐ Two hours
- ☐ Three hours
- ☐ Four hours
- ☐ Five to twelve hours
- ☐ More than twelve hours
- ☐ I do not take pain medication

15) Check the appropriate answer for each item.

I believe my pain is due to:

☐ Yes	☐ No	1. The effects of treatment (for example, medication, surgery, radiation, prosthetic device).
☐ Yes	☐ No	2. My primary disease (meaning the disease currently being treated and evaluated).
☐ Yes	☐ No	3. A medical condition unrelated to my primary disease (for example, arthritis).

Please describe condition: _____

16) For each of the following words, check Yes or No if that adjective applies to your pain.

Aching	☐ Yes	☐ No
Throbbing	☐ Yes	☐ No
Shooting	☐ Yes	☐ No
Stabbing	☐ Yes	☐ No

Gnawing	☐ Yes	☐ No
Sharp	☐ Yes	☐ No
Tender	☐ Yes	☐ No
Burning	☐ Yes	☐ No
Exhausting	☐ Yes	☐ No
Tiring	☐ Yes	☐ No
Penetrating	☐ Yes	☐ No
Nagging	☐ Yes	☐ No
Numb	☐ Yes	☐ No
Miserable	☐ Yes	☐ No
Unbearable	☐ Yes	☐ No

17) Circle the one number that describes how, during the past week, **pain** has interfered with your:

A. General Activity

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

B. Mood

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

C. Walking Ability

0	1	2	3	4	5	6	7	8	9	10

Does not interfere										Completely interferes

D. Normal Work (includes both work outside the home and housework)

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

E. Relations with other people

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

F. Sleep

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

G. Enjoyment of life

0	1	2	3	4	5	6	7	8	9	10
Does not interfere										Completely interferes

18) I prefer to take my pain medicine:

- ☐ On a regular basis
- ☐ Only when necessary

☐ Do not take pain medicine

19) I take my pain medicine (in a 24 hour period):

☐ Not everyday
☐ 1 to 2 times per day
☐ 3 to 4 times per day
☐ 5 to 6 times per day
☐ More than 6 times per day

20) Do you feel you need a stronger type of pain medication?

☐ Yes ☐ No ☐ Uncertain

21) Do you feel you need to take more of the pain medication than your doctor has prescribed?

☐ Yes ☐ No ☐ Uncertain

22) Are you concerned that you use too much pain medication?

☐ Yes ☐ No ☐ Uncertain

If yes, why?

_____

_____

23) Are you having problems with side effects from your pain medication?

☐ Yes ☐ No

Which side effects?

_____

24) Do you feel you need to receive further information about your pain medication?

☐ Yes ☐ No

25) Other methods I use to relieve my pain include: (Please check all that apply)

☐ Warm compresses
☐ Cold compresses
☐ Relaxation techniques
☐ Distraction
☐ Biofeedback
☐ Hyponosis
☐ Other, please specify: _____

26) Medications not prescribed by my doctor that I take for pain are:

_____

_____

Geriatric Depression Scale

Instructions: Choose the best answer for how you felt over the past week.

No.	Question	Answer
1.	Are you basically satisfied with your life?	YES / NO
2.	Have you dropped many of our activities and interests?	YES / NO
3.	Do you feel that your life is empty?	YES / NO
4.	Do you often get bored?	YES / NO
5.	Are you in good spirits most of the time?	YES / NO
6.	Are you afraid that something bad is going to happen to you?	YES / NO
7.	Do you feel happy most of the time?	YES / NO
8.	Do you often feel helpless?	YES / NO
9.	Do you prefer to stay at home, rather than going out and doing new things?	YES / NO
10.	Do you feel you have more problems with memory than most?	YES / NO
11.	Do you think it is wonderful to be alive now?	YES / NO
12.	Do you feel pretty worthless the way you are now?	YES / NO
13.	Do you feel full of energy?	YES / NO
14.	Do you feel that your situation is hopeless?	YES / NO
15.	Do you think that most people are better off than you are?	YES / NO

World Health Organization Disability Assessment Schedule 2.0

This questionnaire asks about difficulties due to health conditions. Health conditions include diseases or illnesses, other health problems that may be short or long lasting, injuries, mental or emotional problems, and problems with alcohol or drugs.

Think back over the past 30 days and answer these questions, thinking about how much difficulty you had doing the following activities. For each question, please circle only one response.

In the past 30 days, how much difficulty did you have in:

Understanding and communicating

D1.1	Concentrating on doing something for ten minutes?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.2	Remembering to do important things?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.3	Analysing and finding solutions to problems in day-to-day life?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.4	Learning a new task, for example, learning how to get to a new place?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.5	Generally understanding what people say?	None	Mild	Moderate	Severe	Extreme or cannot do
D1.6	Starting and maintaining a conversation?	None	Mild	Moderate	Severe	Extreme or cannot do

Getting around

D2.1	Standing for long periods such as 30 minutes?	None	Mild	Moderate	Severe	Extreme or cannot do
D2.2	Standing up from	None	Mild	Moderate	Severe	Extreme or

	sitting down?					cannot do
D2.3	Moving around inside your home?	None	Mild	Moderate	Severe	Extreme or cannot do
D2.4	Getting out of your home?	None	Mild	Moderate	Severe	Extreme or cannot do
D2.5	Walking long distance such as a kilometer [or equivalent]?	None	Mild	Moderate	Severe	Extreme or cannot do
Self-care						
D3.1	Washing your whole body?	None	Mild	Moderate	Severe	Extreme or cannot do
D3.2	Getting dressed?	None	Mild	Moderate	Severe	Extreme or cannot do
D3.3	Eating?	None	Mild	Moderate	Severe	Extreme or cannot do
D3.4	Staying by yourself for a few days?	None	Mild	Moderate	Severe	Extreme or cannot do
Getting along with people						
D4.1	Dealing with people you do not know?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.2	Maintaining a friendship?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.3	Getting along with people who are close to you?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.4	Making new friends?	None	Mild	Moderate	Severe	Extreme or cannot do
D4.5	Sexual activities?	None	Mild	Moderate	Severe	Extreme or cannot do
Life activities						
D5.1	Taking care of your household	None	Mild	Moderate	Severe	Extreme or

	responsibilities?					cannot do
D5.2	Doing most important household tasks well?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.3	Getting all the household work done that you needed to do?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.4	Getting your household work done as quickly as needed?	None	Mild	Moderate	Severe	Extreme or cannot do

Because of your health condition, in the past 30 days, how much difficulty did you have in:

D5.5	Your day-to-day work/school?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.6	Doing your most important work/school tasks well?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.7	Getting all the work done that you needed to do?	None	Mild	Moderate	Severe	Extreme or cannot do
D5.8	Getting your work done as quickly as needed?	None	Mild	Moderate	Severe	Extreme or cannot do

Participation in society

In the past 30 days:

D6.1	How much of a problem did you have in joining in community activities (for example, festivities, religious or other activities) in the same way as anyone else can?	None	Mild	Moderate	Severe	Extreme or cannot do

D6.2	How much of a problem did you have because of barriers or hindrances in the world around you?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.3	How much of a problem did you have because of barriers or hindrances in the world around you?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.4	How much time did you spend on your health condition, or its consequences?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.5	How much have you been emotionally affected by your health condition?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.6	How much has your health been a drain on the financial resources of you or your family?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.7	How much of a problem did your family have because of your health problems?	None	Mild	Moderate	Severe	Extreme or cannot do
D6.8	How much of a problem did you have in doing things by yourself for relaxation or pleasure?	None	Mild	Moderate	Severe	Extreme or cannot do
H1	Overall, in the past 30 days, how many days were these difficulties present?	***Record number of days:*** _____				

H2	In the past 30 days, for how many days were you <u>totally unable</u> to carry out your usual activities or work because of any health condition?	***Record number of days:*** _____
H3	In the past 30 days, not counting the days that you were totally unable, for how many days did you <u>cut back</u> or <u>reduce</u> your usual activities or work because of any health condition?	***Record number of days:*** _____

<u>Multidimensional Scale of Perceived Social Support</u>

Instructions: We are interested in how you feel about the following statements. Read each statement carefully. Indicate how you feel about each statement.

Circle the "1" if you **Very Strongly Disagree**
Circle the "2" if you **Strongly Disagree**
Circle the "3" if you **Mildly Disagree**
Circle the "4" if you are **Neutral**
Circle the "5" if you **Mildly Agree**
Circle the "6" if you **Strongly Agree**
Circle the "7" if you **Very Strongly Agree**

	Very Strongly Disagree	Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree	Very Strongly Agree
There is a special person who is around when I am in need.	1	2	3	4	5	6	7

There is a special person with whom I can share joys and sorrows.	1	2	3	4	5	6	7
My family really tries to help me.	1	2	3	4	5	6	7
I get the emotional help & support I need from my family.	1	2	3	4	5	6	7
I have a special person who is a real source of comfort to me.	1	2	3	4	5	6	7
My friends really try to help me.	1	2	3	4	5	6	7
I can count on my friends when things go wrong.	1	2	3	4	5	6	7
I can talk about my problems with my family.	1	2	3	4	5	6	7
I have friends with whom I can share my joys and sorrows.	1	2	3	4	5	6	7
There is a special person in my life who cares about my feelings.	1	2	3	4	5	6	7
My family is willing to help me make decisions.	1	2	3	4	5	6	7
I can talk about my problems with my friends.	1	2	3	4	5	6	7

Access to Health Care

Health care coverage

1. Do you have any kind of health care coverage, including health insurance, prepaid plans such as HMOs, or government plans such as Medicare?

☐ Yes ☐ No ☐ Unsure ☐ Prefer not to answer

2. Do you have Medicare? (Medicare is a coverage plan for people 65 or over and for certain disabled people.)

☐ Yes ☐ No ☐ Unsure ☐ Prefer not to answer

Provision of health care services

3. Do you have one person you think of as your personal doctor or health care provider?

☐ Yes, only 1 ☐ More than 1 ☐ Unsure ☐ Prefer not to answer

4. How many times have you been to a doctor, nurse, or other health professional in the past 12 months?

_____

Medical costs

5. Was there a time in the past 12 months when you needed to see a doctor but could not because of cost?

☐ Yes, only 1 ☐ More than 1 ☐ Unsure ☐ Prefer not to answer

6. Was there a time in the past 12 months when you did not take your medication as prescribed because of cost? Do not include over-the-counter (OTC) medication

☐ Yes

☐ No

☐ No meds prescribed

☐ Unsure

☐ Prefer not to answer

Socio-demographic Information

Name: _____

Current address: _____

_____

Number *Street* *Apt.#*

State: _____ Zip code: _____

Telephone number: _____

Age: _____

Date of birth: _____

Gender: ❒ Male ❒ Female ❒ Transgender

Marital Status:
❒ Married ❒ Living as married ❒ Separated ❒ Divorced ❒ Single/never married ❒ Widowed

Are you retired?
❒Yes ❒ No

If not, then what is your current occupation: _____

If you are retired, then what was your MAIN occupation: _____

Please select your highest grade completed:

❒ Grade 1	❒ Grade 10
❒ Grade 2	❒ Grade 11
❒ Grade 3	❒ Grade 12
❒ Grade 4	❒ GED
❒ Grade 5	❒ Vocational/training/some college after high school
❒ Grade 6	❒ Associate Degree
❒ Grade 7	❒ College graduate
❒ Grade 8	❒ Some professional school after completing college
❒ Grade 9	❒ Master's Degree

❒ Doctoral Degree (Ph.D., MD, EdD, JD, etc.)

Which of the following best describes your racial or ethnic background (fill in one box)?
❑Hispanic or Latino
❑White/Caucasian
❑Black or African-American
❑Asian
❑Other

What is your total monthly income?

❒ $0-499	❒ $1,500-1,999	❒ Refused to answer
❒ $500-999	❒ $2,000+	
❒ $1,000-1,499	❒ Don't know	

How satisfied are you with your present financial situation?
❒ Completely satisfied
❒ Very satisfied
❒ Somewhat satisfied
❒ Not very satisfied
❒ Not at all satisfied
❒ Don't know
❒ Refused